Trends in abuse and misuse of prescription opioids among older adults

Nancy A. West, Stevan G. Severtson, Jody L. Green, Richard C. Dart

Abstract

Background: Dramatic increases in the prescriptive use of opioid analgesics during the past two decades have been paralleled by alarming increases in rates of abuse and intentional misuse of these drugs. We examined recent trends in the abuse and misuse and associated fatal outcomes among older adults (60+ years) and compared these to trends among younger adults (20–59 years).

Methods: Trend analysis using linear regression models was used to analyze 184,136 cases and 1149 deaths associated with abuse and misuse of the prescription opioids oxycodone, fentanyl, hydrocodone, morphine, oxymorphone, hydromorphone, methadone, buprenorphine, tramadol, and tapentadol that were reported to participating U.S. Poison Centers of the Researched Abuse, Diversion and Addiction-Related Surveillance (RADARS®) System between 2006-Q1 and 2013-Q4.

Results: Rates of abuse and misuse of prescription opioids were lower for older adults than for younger adults; however, mortality rates among the older ages followed an increasing linear trend (P<0.0001) and surpassed rates for younger adults in 2012 and 2013. In contrast, mortality rates among younger adults rose and fell during the period, with recent rates trending downward (P=0.0003 for quadratic trend). Sub-analysis revealed an increasing linear trend among older adults specifically for suicidal intent (P<0.0001), whereas these rates increased and then decreased among younger adults (P<0.0001 for quadratic trend).

Conclusion: Recent linear increases in rates of death and use of prescription opioids with suicidal intent among older adults have important implications as the U.S. undergoes a rapid expansion of its elderly population.

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1. Introduction

Dramatic increases in the prescriptive use of opioid analgesics during the past two decades have been paralleled by alarming increases in rates of abuse, misuse, and use with suicidal intent of these drugs (Institute of Medicine, 2011; Volkow et al., 2014). Further, prescription opioid analgesics have played a key role in driving increases in drug-related deaths over the last decade (Jones et al., 2013; Warner et al., 2011). Overdose deaths involving opioid analgesics now exceed deaths involving heroin and cocaine combined (Center for Disease Control and Prevention, 2011).

Abuse of prescription opioids in older adults occurs when the medication is taken specifically for a psychotropic effect, rather than for treatment of a medical condition. Individuals born between 1946 and 1964 (the baby-boomer generation) are more likely to report use of psychoactive drugs compared to earlier cohorts (Johnson and Gerstein, 1998). Substance abuse is expected to continue as that generation ages into older adulthood (Gfroerer et al., 2003; Han et al., 2009).

The increasing prevalence of chronic pain in the U.S. has been accompanied by an upsurge of therapeutic opioid utilization (Franklin, 2014). Chronic pain has an extremely high prevalence, affecting 100 million adult Americans, and is among the most common reasons for taking medications (Institute of Medicine, 2011). Chronic pain is one of the most prevalent symptoms among older adults and affects this population more than any other age group (Weiner, 2007). A nearly 9-fold increase in opioid prescriptions from office-based medical visits by older adults occurred between 1995 and 2010, suggesting that physicians have pursued greater pain control in this population (Olfson et al., 2013). Due to the greater prevalence of chronic pain, older adults potentially may be more vulnerable to misuse of prescription opioids, such as taking higher than prescribed doses or taking for a longer duration...
than prescribed for management of chronic pain or other diagnosed medical conditions.

Another important hazard of prescription opioid misuse is suicide by self-poisoning. Suicide rates are particularly high among the elderly (Parks et al., 2014). Aging is associated with an increased prevalence of many common illnesses, which, in turn, is associated with an increased risk of suicide (Juurlink et al., 2004). In addition, the coexistence of multiple illnesses confers a marked increased risk of suicide in the older age group. During 2000–2009 in the U.S. there was a 15% increase in suicide mortality rates with the highest rate observed among individuals 75 years and older. During 2000–2009 in the U.S., the coexistence of multiple illnesses confers a marked increased risk of suicide (Juurlink et al., 2004). In addition, the coexistence of multiple illnesses confers a marked increased risk of suicide in the older age group.

The size and current age of the baby-boom generation, coupled with the continued rise in life expectancy, are rapidly increasing the percentage of older adults in the U.S. population. Greater rates of drug abuse among the baby-boom generation, the increasing prevalence of chronic pain associated with an aging population, and increasing suicide rates among older adults portends increasing rates of prescription opioid abuse and misuse among the older adult population. In this study we analyzed recent trends (during 2006–2013) in abuse, misuse, and use with suicidal intent of prescription opioids and associated fatal outcomes among older aged adults and compared these patterns to trends among younger aged adults.

2. Methods

2.1. Data source

This study is based on data from the Researched Abuse, Diversion and Addiction-Related Surveillance (RADARS®) System Poison Centers Program. Poison centers in the U.S. receive spontaneous calls from the general population, caregivers, and healthcare providers regarding potentially toxic exposures, including exposures to prescription opioids. Poison center specialists are nurses and pharmacists trained in toxicology who assist in the care of the individual and document clinical and demographic characteristics of each case. All case data are reported to regional poison centers and are systematically collected using a nationally standardized electronic record. The data are summarized quarterly. The RADARS System Poison Center Program collects the full de-identified case medical record from participating regional poison centers, including urban, suburban, and rural regions. During the time period of the analysis, the RADARS System Poison Center program collected data from 40 to 49 centers that covered from 63% to 92% of the U.S. population. Thorough review was conducted on each case by the RADARS System to validate the reason code. A statistical measure of the inter-rater agreement between the poison centers’ coding of exposure reason and the RADARS System coding was derived from a subset of the data (data from calendar year 2012), demonstrating kappa coefficient = 0.89, which indicated substantial agreement between the two coding sources. Any case coded as abuse, intentional misuse, or use with suicidal intent was regarded as abuse and misuse. In addition to the institutional review board approvals from each participating regional poison center, this protocol was granted exempt status by the Colorado Multiple Institutional Review Board.

2.2. Study sample

We analyzed case counts relating to the abuse and misuse of the prescription opioids oxycodone, fentanyl, hydrocodone, morphine, oxymorphone, hydromorphone, methadone, buprenorphine, tramadol, and tapentadol that were reported to participating poison centers of the RADARS System between January 1, 2006 and December 31, 2013. Cases that were identified with intentional exposure reasons of abuse, misuse, or use with suicidal intent among adults aged 20 years or older were included in the analyses. The following standard definitions were used by the poison center specialists to categorize the intentional exposure reasons: (i) abuse was defined as an exposure resulting from the intentional improper or incorrect use of a substance where the case was likely attempting to gain a high, euphoric effect, or some other psychotropic effect, (ii) misuse was defined as an exposure resulting from the intentional improper or incorrect use of a substance for reasons other than the pursuit of a psychotropic effect or suicidal intent, and (iii) suspected suicidal intent was defined as an exposure resulting from the inappropriate use of a substance for self-destructive or manipulative reasons (AAFPCC, 2007). Calls to poison centers that were determined by the toxicology specialists to be unintentional or accidental exposures to prescription opioids were excluded from this analysis.

Deaths were coded by the poison center when the case ‘probably or undoubtedly’ died as a result of the exposure or as a direct complication of the exposure to a prescription opioid where the complication was unlikely to have occurred had the exposure not preceded the complication (AAFPCC, 2007).

2.3. Measures

Older adult cases were categorized as 60+ years and the remaining adults (ages 20–59 years) comprised the comparison group. We categorized the lowest age of adulthood as 20 years to correspond to the age-specific population data provided by the U.S. Census.

Population rates of exposure to prescription opioids were calculated using quarterly counts of exposures reported to the RADARS System and using age-specific population data for the coverage area from the US Census. Rates were calculated by dividing the total number of intentional exposure calls by the estimated population residing within ZIP codes covered by participating poison centers. The coverage population was estimated using changes in the 2000 and 2010 US Census population estimates at the ZIP Code tabulation area level.

Population estimates used to calculate rates were adjusted for differential growth by age group during the time period. To calculate these estimates, the population within the coverage area of the Poison Center Program was multiplied by the proportion of the 2000 US population that was between 20 and 59 (0.551) and 60 or older (0.163). The population between ages 20 and 59 grew by 8.5% between 2000 and 2010 whereas the population 60 and older grew by 24.6%. This change was interpolated from 2006 to 2010 and extrapolated beyond 2010 for each age group. This approach assumes a linear change in the population at the national level by age group between 2000 and 2010. It also assumes that the change in population beyond 2010 will be equal to the change observed between 2000 and 2010.

2.4. Statistical analysis

Trend analysis was performed using separate ordinary least squares regression models with a second degree polynomial term in adults between the ages of 20–59 and ages 60+. Eight separate regression models were fit. Population rates for each outcome (abuse, misuse, use with suicidal intent, and death) were regressed on a linear term and a second degree polynomial term for year/quarter by age group. The second order polynomial term was not statistically significant (p < 0.05), it was removed from the model. As these data are time-series data, we assessed the presence of autocorrelation using the Durbin-Watson statistic. Findings suggested that residual correlation was minimal with the inclusion of the linear and/or quadratic terms. Residuals from Poison regression models and linear regression models were assessed. Both were determined to approximate a Gaussian distribution. Therefore, we elected to proceed with the linear regression.

3. Results

We identified 184,136 calls reporting abuse, misuse, or use with suicidal intent relating to prescription opioids among adults during the 8-year time period. Table 1 shows the intentional exposure calls by age group. There was a similar proportion of calls made by females among both the age groups. Compared to younger adults,
older adults had a lower average annual rate of calls during the time period (3.4 vs 14.9 calls per 100,000 population), a lower proportion of calls identified as abuse, and a greater proportion of calls identified as misuse. The proportions of calls identified as use with suicidal intent among the two age groups were similar.

Of the total calls related to intentional exposure to a prescription opioid among adults, 16.4% of the calls were categorized as abuse. Rates were lower for older adults than younger adults at every time point (Fig. 1A). A significant quadratic trend was observed for each of the age groups ($P < 0.05$ for each) with rates for each group showing initial increases followed by declines over the time period. Rates of abuse for the older ages peaked later during the time period (early 2013) than younger adults (late 2010). Trend analysis results from the linear regression analyses are presented in Table 2.

Of the total, 18.4% of the calls were categorized as misuse. Rates of misuse were lower for older adults than younger adults at every time point (Fig. 1B). A significant quadratic trend was observed for each of the age groups ($P < 0.05$ for each) with recent rates of misuse for both groups trending downward. Rates of misuse for the older ages peaked later during the period (early 2012) than younger adults (late 2010). Trend analysis results from the linear regression analyses are presented in Table 2.

The majority of the calls (65.2%) were categorized as use with suspected suicidal intent. The suicide intention rates were lower
among the 60+ year age group than the 20–59 year age group for each calendar year/quarter during 2006–2013 (Fig. 1C). Among the older age population there was a significant linear increase in suspected suicidal intent rates over the 8-year time period (P < 0.0001). In contrast, among the younger adults there was a significant negative quadratic trend in population rates over the time period (P < 0.0001) with a rise in rates during 2006–2010 and a decline in rates during 2011–2013. Trend analysis results from the linear regression analyses are presented in Table 2.

There were 1150 deaths from the combined intentional exposure categories of abuse, misuse, and use with suspected suicidal intent among the adults reported to the RADARS System Poison Center program over the 8-year time period. Table 3 shows the deaths associated with the intentional exposure by age group. There was a higher proportion of female deaths among the older cases compared to the younger cases (68.2% vs 55.7%). Older adults had a lower average annual rate of death during the 8-year time period (0.56 versus 0.82 cases per 1,000,000 population). There was a lower proportion of deaths associated with abuse among the older adults compared to the younger adults. The proportion of deaths associated with misuse was similar between the age groups. There was a higher proportion of deaths associated with suicidal intent among the older adults.

Among the older adults there was a significant linear trend in death rates from all intentional exposures to prescription opioids by age category, RADARS System Poison Center Program, 2006–2013 (Fig. 2). In contrast, a significant negative quadratic trend in annual death rates occurred for younger adults (P = 0.0003) during the time period such that death rates increased until 2010 and declined thereafter. Table 4 shows the annual death rates by age group. There was a 2.8-fold increase in death rates for older adults between 2006 and 2013. Of note, from 2006 to 2011, annual death rates for older adults were lower than younger adults; however the death rates for older adults surpassed the rates for younger adults in 2012 and 2013.

### Tables

#### Table 2

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Age group</th>
<th>Intercept</th>
<th>$\beta_{\text{linear}}$</th>
<th>$\beta_{\text{quadratic}}$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abuse</td>
<td>20–59 years</td>
<td>0.581</td>
<td>-0.0263$^d$</td>
<td>-0.0011$^d$</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>60+ years</td>
<td>0.086</td>
<td>-0.00005</td>
<td>-0.0001$^d$</td>
<td>0.68</td>
</tr>
<tr>
<td>Misuse</td>
<td>20–59 years</td>
<td>0.590</td>
<td>-0.0268$^d$</td>
<td>-0.0011$^d$</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>60+ years</td>
<td>0.254</td>
<td>-0.0041</td>
<td>-0.0003$^d$</td>
<td>0.70</td>
</tr>
<tr>
<td>Suicidal intent</td>
<td>20–59 years</td>
<td>2.429</td>
<td>-0.0643$^d$</td>
<td>-0.0031$^d$</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>60+ years</td>
<td>0.869</td>
<td>0.0195$^d$</td>
<td>n/a</td>
<td>0.94</td>
</tr>
<tr>
<td>Death</td>
<td>20–59 years</td>
<td>0.120</td>
<td>-0.0152$^d$</td>
<td>-0.0005$^d$</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>60+ years</td>
<td>0.180</td>
<td>0.0045$^d$</td>
<td>n/a</td>
<td>0.39</td>
</tr>
</tbody>
</table>

$^a$ Rate per 100,000 population per year-quarter.

$^b$ Rate per 1,000,000 population per year-quarter.

$^c$ $P$ < 0.05.

$^d$ $P$ < 0.001.

Note: the regression equations are centered at time = 2013-Q4.

#### Table 3


<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Age 20–59 years</th>
<th>Age 60+ years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total deaths, n (%)</td>
<td>935 (81.3%)</td>
<td>215 (18.7%)</td>
</tr>
<tr>
<td>Average annual rate of death per</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,000,000 population</td>
<td>0.82</td>
<td>0.56</td>
</tr>
<tr>
<td>Exposure reason, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abuse</td>
<td>178 (19.0%)</td>
<td>15 (7.0%)</td>
</tr>
<tr>
<td>Misuse</td>
<td>56 (6.0%)</td>
<td>15 (7.0%)</td>
</tr>
<tr>
<td>Suicidal intent</td>
<td>701 (75.0%)</td>
<td>185 (86.0%)</td>
</tr>
<tr>
<td>Females, %</td>
<td>55.7%</td>
<td>68.2%</td>
</tr>
<tr>
<td>Age at death in years, median (IQR)</td>
<td>42 (32–50)</td>
<td>67 (62–75)</td>
</tr>
</tbody>
</table>

#### Table 4

Annual death rates per 1,000,000 population (95% confidence intervals) from abuse and misuse of prescription opioids by age group, among participating poison centers in the RADARS System Poison Center Program, 2006–2013.

<table>
<thead>
<tr>
<th>Year</th>
<th>Age 20–59</th>
<th>Age 60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>0.58 (0.46, 0.73)</td>
<td>0.27 (0.15, 0.49)</td>
</tr>
<tr>
<td>2007</td>
<td>0.93 (0.78, 1.12)</td>
<td>0.35 (0.21, 0.58)</td>
</tr>
<tr>
<td>2008</td>
<td>1.09 (0.93, 1.28)</td>
<td>0.44 (0.29, 0.69)</td>
</tr>
<tr>
<td>2009</td>
<td>0.91 (0.77, 1.08)</td>
<td>0.48 (0.32, 0.72)</td>
</tr>
<tr>
<td>2010</td>
<td>0.99 (0.84, 1.16)</td>
<td>0.51 (0.35, 0.76)</td>
</tr>
<tr>
<td>2011</td>
<td>0.76 (0.63, 0.91)</td>
<td>0.65 (0.46, 0.92)</td>
</tr>
<tr>
<td>2012</td>
<td>0.76 (0.64, 0.91)</td>
<td>0.88 (0.68, 1.17)</td>
</tr>
<tr>
<td>2013</td>
<td>0.63 (0.52, 0.76)</td>
<td>0.77 (0.57, 1.04)</td>
</tr>
</tbody>
</table>

#### Figure 2

Quarterly death rates, with fitted trend lines, from abuse and misuse of prescription opioids per 1,000,000 population by age category, RADARS System Poison Center Program, 2006–2013.
highlighted that although opioid-analgesic poisoning
Another recent report from the U.S. Centers for Disease Control and
Prevention highlighted that although opioid-analgesic poisoning
death rates increased rapidly between 1999 and 2011, the rate of
increase slowed between 2006 and 2011 (Chen et al., 2014). Our
results also show a slowing of deaths rates as well as a slowing of
rates associated with abuse, misuse, and use with suicidal intent
between 2006 and 2011, particularly among younger age adults.
Because our surveillance system captures data in near real time,
we were able to identify a decrease in rates after 2011.

4.1. Strengths and limitations

The extensive coverage area, large sample, timeliness, speci-
cificity of exposure, and quality of the data make poison center
records attractive for surveillance purposes. Further, we included
32 time points (calendar year quarters) over 8 years in our analy-
ses. Additionally, data on prescription opioid drug abuse and misuse
from the RADARS System Poison Center Program has been shown to
correlate well with emergency department data (Davis et al.,
2014). However, poison center reports are passive data collection
systems that likely result in an underreporting of the number of
cases, particularly for exposures in which clinical effects are not
severe. Poison center data will also underestimate the incidence of
prescription opioid-related deaths because individuals discovered
already deceased are often not reported to a poison center. A further
limitation is the potential for selection bias – it is unclear whether
the variations observed in this study can be accounted for by dif-
fferences in poison center use by age over the time period. Selection
bias would require that the rates of abuse, misuse, or use with sui-
cidal intent of prescription opioids were different between those
who did and did not call a poison center and that this difference
varied between the older and younger adults. Other limitations
inherent to using poison center data include miscoding and miss-
ing data; however, these limitations are minimized by thorough
training of poison center specialists and by the RADARS System rig-
orous quality control process. Although inclusion of only RADARS
System poison centers may affect the generalizability of our find-
ings, the geographic area represented in this analysis included large
metropolitan areas in the country as well as regions with a consid-
erable rural population.

The recent consistent increases in rates of use with suicidal intent
and fatal outcomes from the exploitation of prescription opioids
among adults aged 60+ years may have important implications
as the U.S. undergoes a rapid expansion of its elderly population.
More data are needed to determine if older adults may be emerging
as a high risk group for prescription opioid abuse and misuse.

Role of funding source

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and Addiction-Related Surveillance (RADARS®) System, which is
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is supported by subscriptions from pharmaceutical manufacturers
of prescription opioid analgesics, which use these data for pharma-
covigilance activities and to meet regulatory obligations. None of
the subscribers had any role in the study design; collection, analy-
sis and interpretation of data; writing of the report; or the decision
to submit the article for publication.

Contributors

N. West and J. Green designed the study. N. West and S.G.
Severtson conducted the statistical analyses. All the authors
were responsible for the interpretation of the data. N. West wrote the
first draft of the manuscript. All authors contributed vital information
for completion of the manuscript and all have approved the
final manuscript.

Conflict of interest

The authors are affiliated with the RADARS System, an inde-
pendent nonprofit postmarketing surveillance system that is
supported by subscription fees from pharmaceutical manufactur-
ers. None of the authors have a direct financial, commercial, or other
relationship with any of the subscribers.

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