Trends in Pediatric Opioid Ingestion and Associated Factors in Washington State, 2014-2023

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Abstract

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Opioid intoxication in children is a growing concern. This study evaluates trends in pediatric opioid ingestions in Washington state. This retrospective study involves review of call report data from the Washington Poison Center on non-therapeutic opioid ingestions in children and adolescents aged 0-17 years between the years of 2014-2023. Trends were assessed based on opioid type and demographic factors. Logistic regression analysis was performed, presented as odds ratio [95% confidence interval]. A total of 2,878 pediatric opioid ingestions were reported; mean age was 7.4 [0.083, 17] years with a slight female predominance (52%). Over the nine-year period, there was a significant trend in increased fentanyl use (97% increase) compared to oxycodone (56% decrease) and hydrocodone (59% decrease). Fentanyl ingestion (OR 4.25 [2.88-6.22]), adolescent age (OR 2.00 [1.48, 2.70]), and high neighborhood socioeconomic disadvantage (OR 1.91 [1.36, 2.73]) had increased odds of a major effect (life threatening or disfiguring). The most recent trends of pediatric opioid ingestion in Washington state show a disproportionate increase in fentanyl ingestion and an associated increased odds of life-threatening effects.

INTRODUCTION

Since its beginnings in the 1990s, the opioid epidemic has continued to evolve as a public health crisis. The first two waves of the epidemic were characterized by aggressive prescription of opioid medications and illicit use of highly addictive opioids such as heroin. The most recent wave began in 2013 with the marked rise in synthetic opioid overdose related deaths, namely due to use of high potency synthetic opioids like fentanyl [1]. In 2023, there were 81,083 opioid-related deaths in the United States (US), representing 75% of all drug overdose-related deaths; 92% of the opioid cases involved high potency synthetic opioids (primarily fentanyl) [2]. For reference, fentanyl has a potency 100 times stronger than morphine and 50 times stronger than heroin. Given this potency, fentanyl has been judiciously used therapeutically by physicians to treat acute severe pain. However, the production of fentanyl has shifted from pharmaceutical companies to illicit manufacturing through drug cartels. Illicit fentanyl and its analogues are increasingly mixed with other substances such as sedatives to increase its resultant experienced high but also increase addictive potential and lethality [3]. In 2023, about 7 in 10 drug overdose deaths in the United States involved illegally manufactured fentanyl [4]. Washington state has experienced a higher burden of drug overdose-related deaths: between 2022 and 2023, there was a nationwide decrease in overdose attributed deaths of 3.7% while at the same time overdose deaths increased more than 27% in Washington [2].

Although adolescents and children face increased mortality due to the opioid crisis the extant literature has largely ignored impacts on the pediatric population and focused on the adult population. Opioids are the leading cause of fatal poisonings in young children in the US, having increased from 24.1% in 2005 to 52.2% in 2018 of all pediatric poisoning deaths in the US [5],

and opioid-related overdoses among children in the US ages 1-4 years have increased over 200% from 1995 to 2012 [6]. Fentanyl is now the primary agent in the pediatric opioid crisis, which mirrors trends noted in the adult opioid crisis [7], and this high-potency opioid poses increased risk for intensive care unit admissions and deaths among hospitalized children [8]. Despite this evidence of the impact that the opioid crisis has had among the pediatric population, too little attention has been paid in the scientific literature to the role that opioid and in particular fentanyl poisoning has among all children. To our knowledge there has been no research into the specific impact of pediatric opioid poisonings in Washington state. To address this gap in the evidence base, we examine the trends and key factors that impact health outcomes of opioid ingestion among children and adolescents in Washington state, within the most recent wave of the opioid pandemic.

METHODS

Study Design

We conducted a retrospective cohort study using the report registry from Washington Poison Center. Cases included in this study were all Washington state residents aged 17 and younger with an acute opioid ingestion that was reported to the Washington Poison Center from January 2014 to December 2023. All opioid ingestions were non-therapeutic intoxications that occurred within the same day of the call with a subsequent initial report filed at the Washington Poison Center. All opioid ingestions were confirmed by observation of the event and/or medical toxicology and laboratory testing. In cases of multi-substance consumption, only the opioid ingestion cases were included. Each opioid substance was counted as an individual ingestion.

Data Source and Selection

One of 55 poison centers nationwide, the Washington Poison Center (WAPC) is a non-profit organization that since 1956 has served as a statewide public health safety net for cases of poison and toxin exposure. WAPC specialists are available 24 hours a day and 7 days a week throughout the entire year to provide immediate, free assistance and expertise. WAPC responds to more than 138,000 calls per year from both the general population and medical professionals. The WAPC follows each reported case from the initial report to the final resolution of the case with all of this information included in the registry.

Call report data was extracted from manually completed electronic forms and stored in a spreadsheet. Demographic variables available from the registry are patient age, gender (male or female), patient's home zip code of patient and county of residence. Age is recorded in the following groups: young child (0-3 years of age), child (4-9 years of age), preadolescent (10-13 years of age), and adolescent (14-17 years of age). In addition to this individual patient information, we also included the Area Deprivation Index (ADI) for their home zip code. ADI is a multifactorial proxy used to assess socioeconomic advantage in a United States neighborhood relative to the state or nation [9, 10]. ADI uses US census data. Lower ADI deciles and percentiles signify less deprivation in the community. Our analysis included the ADI for each patient's zip code for the state decile and national percentile. We also include the ADI for each of the state's nine Accountable Community of Health (ACH). ACHs are regional organizations where healthcare providers and community organizations collaborate to address health and social needs-related projects and activities in their specific region [11]. Acute ingestion related

variables included year of ingestion, number of products ingested, the opioid's name and formulation, reason for ingestion, location of ingestion, and medical outcome for each unique incident. Medical outcome was defined as hospital level of care (discharge home from emergency department, admission to acute care or admission to intensive care unit [ICU]) and effect (no effect, minor effect, moderate effect, major effect, or death). Minor effect was defined as mild, transient duration (< 2 hours) symptomatology without any lasting physiological effects. Moderate effect was defined as a physiological effect without threat to life but that required several hours of medical observation and medical treatment for resolution. Major effect was defined as life-threatening injuries requiring ICU admission for prolonged medical treatment (≥ 1 day).

Analysis

We examined the trends in opioid poisoning over time among children in Washington state as a function of demographic factors, the type of opioid ingested and medical outcomes. Tests of statistical differences over time were conducted using unpaired t-tests for continuous variables and a chi square rf Fischer's exact test based on size of the sample for categorical variables. Continuous variables were represented as mean (standard deviation). Univariate and multivariable logistic regression analyses were done. Resultant odds ratio (OR) values were presented with [95th percentile confidence interval]. All analysis was performed using the R Project for Statistical Computing (Vienna, Austria).

RESULTS

Descriptive statistics for the 2,878 unique pediatric opioid ingestions reported to the Washington Poison Center between 2014-2023 are reported in Table 1. In almost all cases there was one reported ingested opioid with 120 instances of two and 7 with three ingested opioids. Mean patient age was 7.4 years old (SD 6.5, range 0.083 to 17]) with more than half aged 3 or younger (51%) or female (52%). King and Pierce each had approximately 15% of the state's population had the largest number of cases(n = 691, 24% and n = 500, 17%, respectively).

Reported opioid ingestion cases were primarily from communities in the lower half of the national ADI percentiles but from higher Washington state specific ADI deciles (Figure 1) at each time point. This is likely due to Washington state having higher socioeconomic circumstances than the national at large. Less than 10% (n = 244) cases did not have ADI values available due to high-population residency suppression. Pediatric opioid ingestion trends showed a significant increase in the incidence rate of fentanyl use though oxycodone and hydrocodone were the most prevalent opioids ingested overall (Figure 1). From 2014-2023, fentanyl was the only substance that increased in incident ingestions. There was a 97% increase in fentanyl ingestion compared to a 56% decrease in hydrocodone ingestion and 59% decrease in oxycodone ingestion over the entire study period. A total of 205 fentanyl ingestions were reported: 93 young child cases, 14 child cases, 12 preadolescent cases, and 84 adolescent cases. Fentanyl ingestion incidence substantially increased for all age groups over the study period, especially among the young child and adolescent age groups (Supplementary Figure 1). Mean age in years, age group, gender and ADI decile were factors significantly associated with pediatric fentanyl ingestion (Table 1).

Reasons for opioid ingestion were: 68% unintentional, 21% intentional-suicide attempted, 8% intentional-abuse, and 3% intentional-misuse. All ingestions in the 0-3 year old children were unintentional while most (72%) of the ingestions among 14-17 year adolescents were intentional, associated with an attempted suicide (Figure 2). Most cases resulted in a "no effect" (n = 816, 28%) or "minor effect" (n = 1375, 48%). There were 406 cases (14%) with moderate effect, 272 cases (10%) with major effect and nine reported deaths. Mean age in years, age group, gender, mean state decile, state ADI decile, fentanyl ingestion, and hydrocodone ingestion were significantly associated with a major effect outcome (Table 2). On univariate logistic regression, mean age in years, child age group (4-9 years old), preadolescent age group (10-13 years old), adolescent age group (14-17 years old), female gender, mean state decile, high state ADI decile (deciles 6-10), fentanyl ingestion, and hydrocodone ingestion were associated with a major effect outcome. Mean age (OR 1.04 [1.02-1.06]), adolescent age group (OR 1.982 [1.54, 2.55]), ADI state decile (OR 1.10 [1.04, 1.16]), high state ADI decile group (OR 2.11 [1.52, 2.99]), and fentanyl ingestion (OR 5.38 [3.86, 7.44]) had increased odds for major effect outcome. After multivariable logistic regression, mean age (OR 1.05 [1.02-1.07]), adolescent age group (OR 2.00 [1.48, 2.70]), mean state decile (1.09 [1.03-1.16]), high ADI state decile (OR 1.91 [1.36, 2.73]), and fentanyl ingestion (OR 4.25 [2.88-6.22]) had increased odds of a major effect outcome. Hydrocodone ingestion was associated with decreased odds of major effect outcome (OR 0.345 [0.202-0.554]).

DISCUSSION

This study describes incidence trends in pediatric opioid ingestion and associated factors in Washington state over a nine-year period within the current era of the nationwide opioid

epidemic, which is defined by the growth in the distribution of high-potency opioids. There are very few studies that evaluate opioid intoxications within this vulnerable population. Available literature on opioid intoxications in children and adolescents has a national scope; there remains a lack of state-specific analyses [8,12-13]. This study focused on patients under 18 years of age within Washington state, given its disproportionately higher burden of drug overdoses compared to other states. The Washington State Department of Health has publicly available data on opioid drug overdose data but lacks a more granular focus by age group with the under-18 population and does not include analysis of neighborhood socioeconomic measures [14-15].

In this study, incidence of fentanyl ingestion within the pediatric population disproportionately increased from 2014 to 2023 compared to other opioid drugs and was associated with older age (particularly the adolescent age 14-17 years) and higher ADI state decile. Another state that has published analyses on pediatric opioid ingestions is the neighboring state of Oregon. The increase in reported fentanyl ingestion in Washington is consistent with data from Oregon. The Oregon Poison Center at the Oregon Health and Science University published in the New England Journal of Medicine a substantial rise in illicit fentanyl ingestion in children younger than 6 years old in Oregon: from 0 cases in 2013 and 2 cases in 2021 to 16 cases in 2023 [16]. The prevalence of reported fentanyl ingestions, particularly young children, is higher in Washington. The study presented here also showed that older age (especially the adolescent age group), higher ADI decile, and fentanyl ingestion were associated with increased odds of life-threatening injuries for the child or adolescent.

The reason for ingestion data shown suggests that the young child and adolescent age groups are distinct in risk factors; identification of these differences allows for tailored public health policy. The unintentional ingestions by young children point to exposures in a home where opioid substances are not properly secured out of the child's reach. The intentional ingestions, particularly those related to suicide attempts, among the adolescent age group point to underlying mental and behavioral health needs that have not been adequate addressed [17-19]. The reported data presented here also indicates a disproportionately higher burden of pediatric opioid ingestions, especially of fentanyl, in more disadvantage neighborhoods and counties. Socioeconomic factors remain a key factor in exposure and life-threatening or fatal outcomes of opioid drug intoxication as seen in adults [20]. Parental opioid misuse and abuse has been noted in literature as a risk factor for pediatric opioid exposure, thus addressing healthcare and addiction treatment access among adults will likely also help address the pediatric opioid ingestion burden [21]. However, the pediatric population has its own particular risk factors; addressing this population specifically necessitates awareness first.

Decreasing the incidence of pediatric opioid ingestions will involve removing access to these drugs in homes, developing safe practices, and harm reduction. In 2024, the Washington State Legislature adopted House Bill 6109, which directly addresses child safety in the context of fentanyl exposure and measures for removing children from opioid-related abuse and neglect. In the same year, House Bill 1956 directly responded to opioid-related injury among the pediatric population in Washington, addressing preventative measures for high-potency opioids like fentanyl. It establishes education for the public, including in schools. Education is an important part of preventative practices as studies shows that nearly half of adults receiving opioid

medication do not recall being given information for safe storage, thus putting children in the home at risk [22]. The Washington State Health Care Authority has a *Starts with One* initiative that sends individuals free medication mail-back envelopes on request. Health care providers can play a role in education of safe use of opioids; patients at an outpatient palliative clinic were significantly more likely practice safe use techniques (proper storage and disposal) following educating the patient through discussion and a written brochure [23]. Equipping individuals and families with naloxone is a safety practice and also a form of harm reduction. Naloxone (Narcan ®) is an opioid antagonist that diminishes the physiological effects of opioid overdose and can also be used in children and adolescents. Washington state has a standing order for naloxone for those with Medicaid but could also expand distribution of naloxone kits to schools, which is being done by South Carolina Department of Public Health [24].

There are limitations to this study, particularly due to its retrospective nature. Given this retrospective approach, our analysis showed associated factors with pediatric opioid ingestions and could not determine causation. Data was based on reported ingestions, and Washington state does not have mandatory reporting by parents/guardians or health professionals. Thus the burden of pediatric opioid ingestions in this study likely underestimates the true burden. Poison center data also does not include race and ethnicity, a demographic factor that is known to be associated with socioeconomic status. Socioeconomic status was included via the validated proxy measure ADI. Given that ADI is based on census data, scores for zip codes with very small populations (<100 people) or a high density of the population living in group homes were suppressed. The Neighborhood Atlas® that provides ADI scoring does not calculate a decile block group for these zip codes in order to not have stark outliers within the population data. Suppressed values

comprised a very small subset of our data. This study does make a first step in characterizing the current landscape of pediatric opioid ingestions in Washington state. This study aims to motivate further collaborative studies and policy measures that bring awareness to this problem, improve data reporting and address risk factors tailored by age group.

CONCLUSION

Pediatric opioid ingestion is an increasing problem within the opioid epidemic and remains understudied. Current trends of pediatric opioid ingestion in Washington state show a disproportionate increase in pediatric fentanyl ingestion. Fentanyl ingestion and life-threatening effects are associated with adolescent age and being from a socioeconomically disadvantage community. Further research and policy is needed to address this important public health issue.

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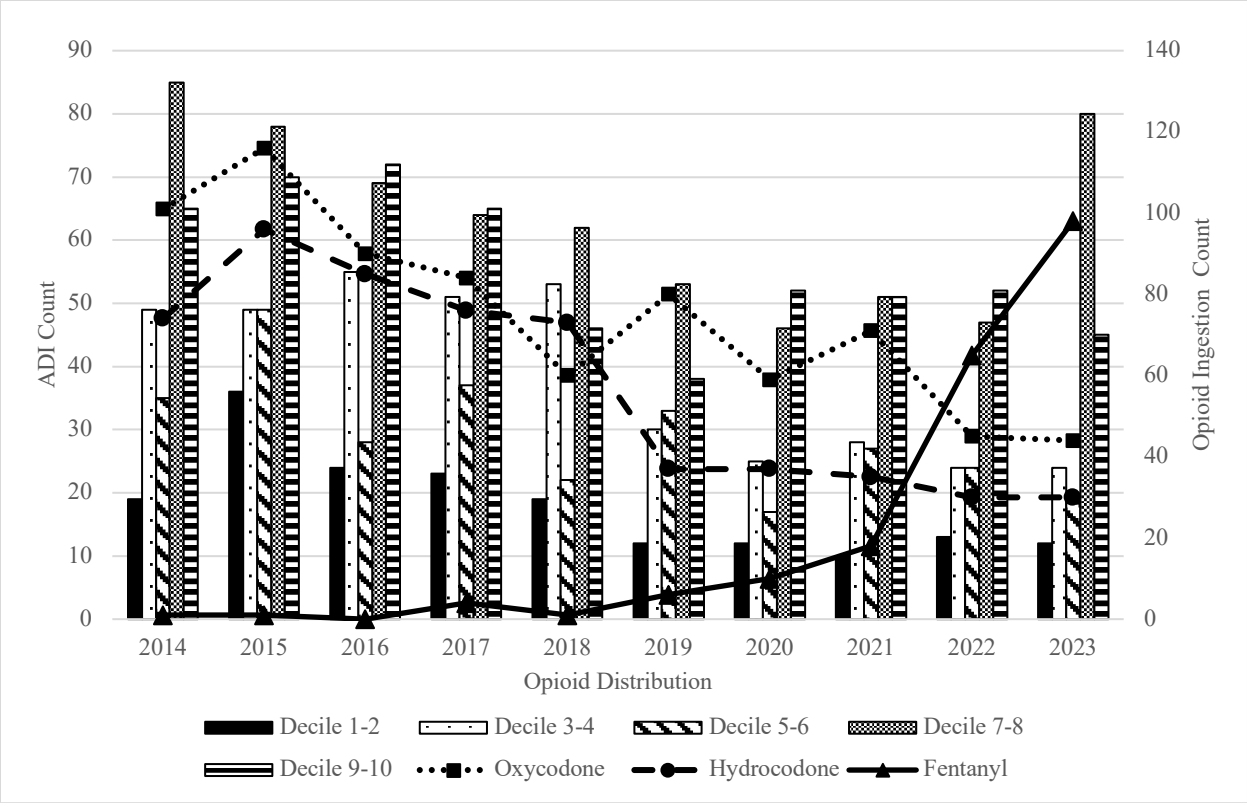


FIGURE 1 — Pediatric Opioid Ingestion and State Area Deprivation Index (ADI) Decile Stratified By Year: State of Washington, United States, 2014-2023.

TABLE 1 – Pediatric Fentanyl Ingestions Based on Demographic Factors: State of Washington, United States, 2014-2023

Factor	All Patients	No Fentanyl Use	Fentanyl Use	p-value
Age, mean (SD)	7.36 ± 6.5	7.28 ± 6.4	8.46 ± 6.9	0.019*
Young Child (0-3 years old)	1467 (51%)	1374 (94%)	93 (6%)	0.002*
Child (4-9 years old)	299 (10%)	285 (95%)	14 (5%)	0.002*
Pre-adolescence (10-13 years old)	172 (6.0%)	160 (93%)	12 (7%)	0.002*
Adolescent (14-17 years old)	935 (32%)	851 (91%)	84 (9%)	0.002*
Gender				
Female	1479 (52%)	1385 (94%)	94 (6%)	0.014*
Male	1393 (48%)	1284 (92%)	109 (8%)	0.014*
ADI State Decile, mean (SD)	6.47 ± 2.6	6.43 ± 2.7	7.01 ± 2.4	0.003*
Decile 1-5	898	864	34	<0.001*
Decile 6-10	1736	1608	128	<0.001*
ACH				
Better Health Together	381 (13%)	352 (92%)	29 (8.0%)	0.053
Choice	260 (9%)	249 (96%)	11 (4.0%)	0.053
Elevate Health	500 (17%)	455 (91%)	45 (9%)	0.053
Healthier Here	691 (24%)	630 (91%)	61 (9%)	0.053
Olympic Community of Health	136 (5%)	130 (96%)	6 (4%)	0.053
Thriving Together North Central WA	116 (4%)	106 (91%)	10 (9%)	0.053
Greater Health Now	270 (9%)	260 (96%)	10 (4%)	0.053
North Sound	416 (14%)	391 (94%)	25 (6%)	0.053
SWACH	98 (3%)	91 (93%)	7 (7%)	0.053

Abbreviations: ACH, Accountable Communities of Health; ADI, area deprivation index; SD, standard deviation.

*p-value < 0.05 denotes a statistically significant association

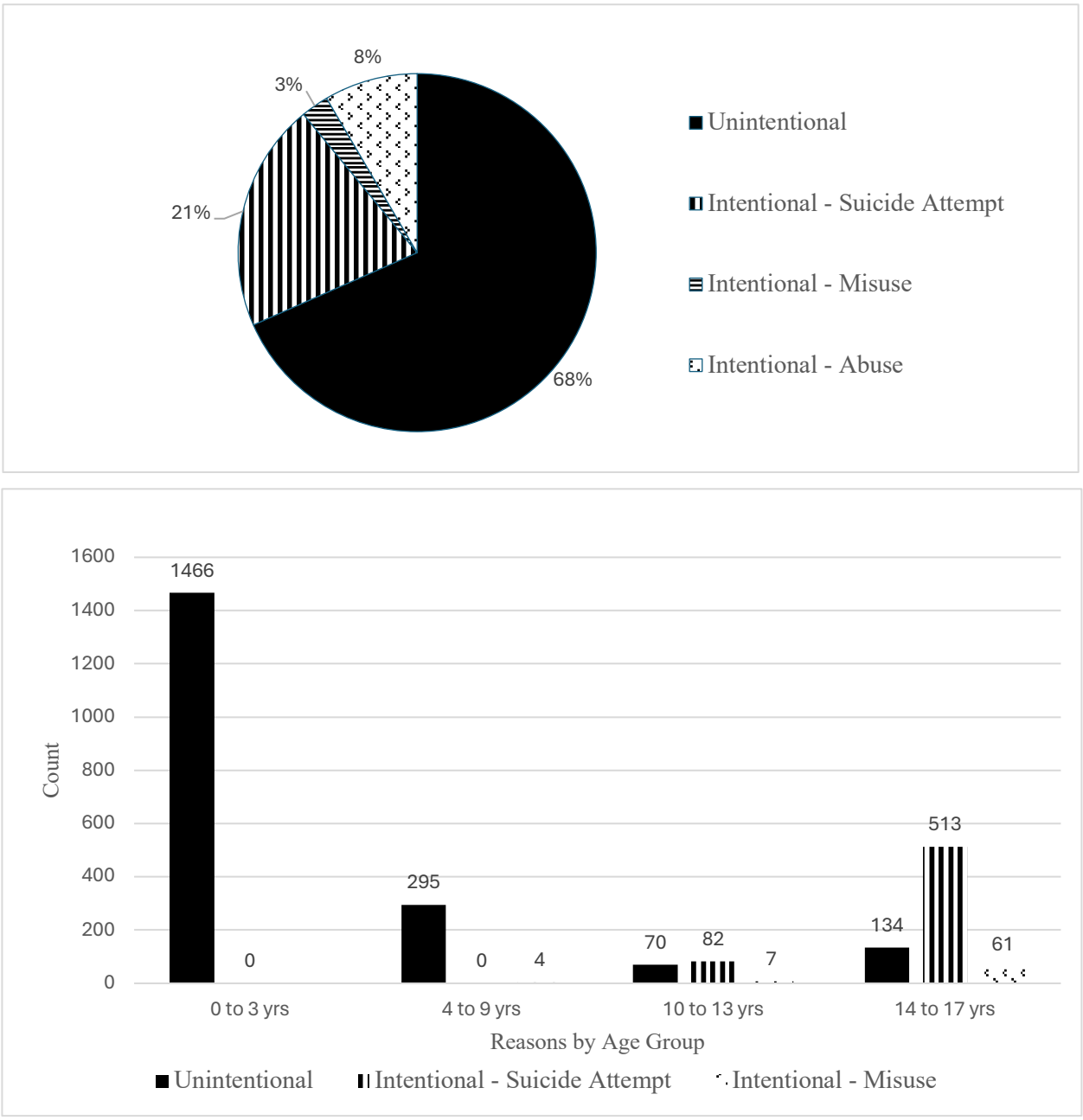


FIGURE 2 — Reason for Pediatric Opioid Ingestion: State of Washington, United States, 2014-2023.

TABLE 2 – Major Effect Outcome Based on Demographic Factors: State of Washington, United States, 2014-2023

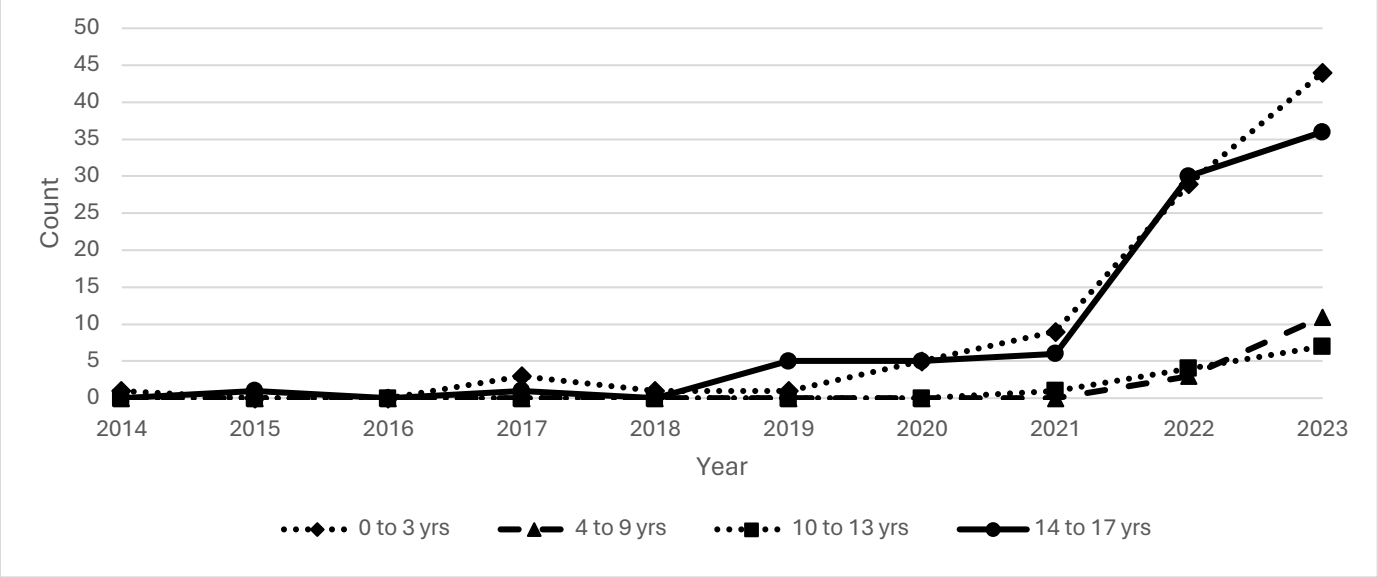
Factor	All Patients	No Severe Outcome	Severe Outcome	p-value
Age (SD)	7.36 ± 6.5	7.21 ± 6.4	8.81 ± 7	<0.001*
Young Child (0-3 years old)	1467 (51%)	1342	125	<0.001*
Child (4-9 years old)	299 (10%)	287	12	<0.001*
Preadolescence (10-13 years old)	172 (6.0%)	165	7	<0.001*
Adolescent (14-17 years old)	935 (32%)	807	128	<0.001*
Gender				
Female	1479 (52%)	1363	116	0.002*
Male	1393 (48%)	1239	154	0.002*
State Decile	6.47 ± 2.6	6.42 ± 2.7	7.04 ± 2.4	<0.001*
Decile 1-5	898 (31%)	853	45	0.001*
Decile 6-10	1736 (60%)	1562	174	0.001*
Type of Opioid Ingested				
Fentanyl	205 (7.1%)	141	64	<0.001*
Oxycodone	750 (26%)	687	63	<0.001*
Hydrocodone	573 (20%)	553	20	<0.001*

Factor	Univariate OR	Univariate p-value	Multivariate OR	Multivariate p-value
Age, mean (SD)	1.04 [1.02-1.06]*	<0.001*	1.05 [1.02-1.07]	<0.001*
Young Child (0-3 years old)	0.801 [0.623, 1.028]	0.0824	--	--
Child (4-9 years old)	0.373 [0.195, 0.645]*	0.001*	0.369 [0.163, 0.725]	0.008*
Preadolescence (10-13 years old)	0.391 [0.165, 0.781]*	0.016*	0.625 [0.257, 1.30]	0.248
Adolescent (14-17 years old)	1.982 [1.54, 2.55]*	<0.001*	2.00 [1.48, 2.70]	<0.001*
Gender				
Female	0.170 [0.033, 1.24]*	0.042*	0.506 [0.060, 10.9]	0.573
Male	0.249 [0.048, 1.80]	0.1097	--	--
ADI State Decile, mean (SD)	1.10 [1.04, 1.16]*	<0.001*	1.09 [1.03-1.16]	0.002*
Decile 1-5	0.474 [0.334-0.658]*	<0.001*	--	--
Decile 6-10	2.11 [1.52, 2.99]*	<0.001*	1.91 [1.36, 2.73]	<0.001*
Type of Opioid Ingested				
Fentanyl	5.38 [3.86, 7.44]*	<0.001*	4.25 [2.88-6.22]	<0.001*

Oxycodone	0.842 [0.622, 1.123]	0.253	--	--
Hydrocodone	0.295 [0.179, 0.457]*	<0.001*	0.345 [0.202-0.554]	<0.001*

Abbreviations: ADI, area deprivation index; OR, odds ratio; SD, standard deviation.
*p-value < 0.05 denotes a statistically significant association

SUPPLEMENTARY



SUPPLEMENTARY 1 — Pediatric Fentanyl Ingestion Over Time, Stratified By Age Group: State of Washington, United States, 2014-2023.