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# Examining adolescents' opioid knowledge and likelihood to Utilize an educational game to promote medication safety

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## Abstract

**Background:** Adolescents' knowledge on opioids is seldom studied, despite the fact young people are one of the groups most affected by the opioid crisis within the United States. There is a need to understand adolescents' perceptions about opioid misuse and safety to create the necessary tools to educate adolescents on safe opioid use.

**Objective:** This study sought to understand adolescents' knowledge and perceptions of opioid use and safety as well as their receptiveness to using an educational game for improving medication safety knowledge.

**Methods:** A 67-item survey was developed to assess adolescents' opioid perceptions, knowledge, and the likelihood of an educational game to enhance their opioid medication safety. A nationally representative sample of US adolescents aged 12 to18 were recruited via a Qualtrics participant panel to complete the online survey from October through November 2020. Survey questions were grouped into 10 categories to represent key concepts and summarized into concept scores. Concepts were described through means, median, and range as well as percent correct for individual questions. Differences between groups were assessed using Kruskal-Wallis tests. Concept scores and their relation to the participant's age were described by the Pearson's correlation coefficient and the linear model coefficient.

**Results:** A total of 592 responses were analyzed. Male and older participants reported greater perceived opioid knowledge than females. White participants reported higher rates of perceived opioid knowledge, behavioral intent, and knowledge of safe medication disposal than any other racial group. About 80% of participants were receptive to the use of an educational game to increase their opioid safety knowledge.

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Declaration of competing interest

None.

CRediT author statement

**Olufunmilola Abraham:** Conceptualization, Methodology, Writing - Review & Editing **Claire A. Rosenberger:** Writing - Original Draft, Writing - Review & Editing Jen Birstler: Formal analysis, Writing - Original Draft, Writing - Review & Editing **Kathleen Tierney**: Writing - Original Draft, Writing - Review & Editing.

**Conclusions:** There are discrepancies in adolescents' knowledge on opioid safety and harm amongst genders, race, and age. Study findings support the use of an educational game to increase adolescents' opioid knowledge. Future studies should design an educational game intended for a diverse audience.

### Keywords

Adolescents; Opioid medication safety; Educational game; Opioid crisis; Naloxone (Narcan®)

## 1. Introduction

In 2019, approximately 50,000 people in the United States died from an opioid-related overdose, and 7.6% of adolescents reported opioid misuse.[1,2] Pain is one of the main reasons individuals in the United States seek healthcare, and in 2016, the most reported cause for opioid misuse was to relieve physical pain.[3,4] Adolescents with a history of chronic pain are more likely to misuse opioids; 84%–88% of adolescents report using opioids in ways other than how they were prescribed to help treat pain.[5,6] Additionally, adolescents prescribed opioids before 12th grade are at a significant risk of misusing opioids later in life.[2,7,8] One potential reason for adolescent opioid misuse is the inconsistent information provided on how to treat pain and what constitutes misuse of opioid medications. The Centers for Disease Control and Prevention (CDC) describes various actions that refer to opioid misuse, such as using someone else's prescription opioid medication, consuming opioids in a way other than as directed on their prescription, and sharing opioid medications with others, but the CDC does not provide a clear definition for opioid misuse.[9] In addition, the CDC does not have guidelines or recommendations for pain management in children.[10] Furthermore, prior research found that 64% of clinicians do not have a protocol for prescribing pain management.[11] There needs to be a clear and easy way to educate adolescents on how to use opioids correctly and what signifies misuse, so they can make informed decisions when prescribed opioid medications.

### 1.1. Opioid knowledge among teens

To use prescription medications safely and responsibly, knowledge on how to properly use, store, and dispose of medicines is critical. Studies have shown that adolescents have limited knowledge about opioid medications.[12–16] Adolescents have a basic understanding of opioids and the consequences of misuse, but they are often unable to identify which medications are opioids.[12] Adolescents are knowledgeable about prescription opioid use, but they are uninformed of their addictive potential and the related risks of overdose.[15] Most adolescents are familiar with the behavioral signs of opioid addiction, but they are unaware of the accessibility of naloxone (Narcan®) to reverse overdoses.[16] Additionally, adolescents report contradictory perceptions about opioid medications. About 80% of surveyed adolescents recognized short-term use of opioids can cause addiction; however, almost half reported they did not think they would become addicted after short-term opioid use.[12] Most adolescents are aware of the potential dangers of opioids and the importance of keeping them out of reach of children.[16] Nevertheless, they report sharing, stealing, and improperly storing prescription medications.[16]

### 1.2. Gender, age, and race differences

Gender, age, and race are important factors that influence opioid misuse and/or the lack of knowledge on how to correctly use the medication. Differences among genders for opioid knowledge and use are primarily due to external factors such as parenting styles, peer pressure, and opioid prescription practices. Parental supervision and guidance often differ between males and females and can lead to parents being less aware of their child's behavior and/or make them think differently about a child's actions towards opioid misuse.[17] Opioid misuse is also influenced by social factors such as peer pressure, which can vary by gender.[18] Furthermore, females are twice as likely than males to be prescribed opioids.[19] Women report more chronic conditions that cause pain, which can be associated with higher prescription rates of opioids.[19] Race is also a factor to consider when examining opioids use and knowledge. Racial and ethnic minorities are at a higher risk of receiving inadequate treatment for pain than those who are in the majority.[20] One study found White children were prescribed fewer opioids after having a medical procedure than Black children, which could make them less likely to use opioids long-term.[21–23] Additionally, the prevalence of misusing opioids is higher among Hispanic adolescents than Black or White adolescents, with Hispanic females reporting the most misuse.[24]

There are also age differences when it comes to opioid use, knowledge, and perceptions.[24] Prescription opioid misuse usually begins in adolescence and peaks at ages 18–21 years.[25] However, individuals younger than 25 years believe they will not become addicted to prescription opioids after short-term use, despite research showing they are in an at-risk age group for opioid misuse and addiction.[12] Additionally, a national survey found the number of adolescents reporting having ever misused prescription pain medicine, including taking the drug without a doctor's prescription or differently than how they were prescribed, is higher among 11th-grade (15.4%) and 12th-grade (17.0%) than 9th-grade (10.9%) students, suggesting older students are more likely to misuse opioids than their younger peers.[24]

### 1.3. Existing educational opioid programs

With the opioid epidemic increasingly affecting adolescents, new educational interventions have been developed to support adolescents' learning and understanding of opioids. For example, 'Opioid Lifeline' developed *This is (Not) About Drugs*, one of the first youth-focused educational programs aimed at addressing the opioid health crisis.[26] It educates adolescents in a classroom setting on how addiction can stem from misuse, symptoms of an overdose, the use of naloxone (Narcan®), and provided resources for helping adolescents use opioids correctly.[26] Other organizations, such as 'Rx for Addiction', have created educational programs focused on medication safety, signs of misuse, withdrawal, and overdose through role-play, case scenarios, and social media.[27] While there are several interventions that have been shown to be helpful for adolescents, there are limited studies that measure adolescents' receptiveness for an educational game on promoting safe medication use.[28]

Opioid misuse in adolescents is not adequately addressed in current literature. Few studies have examined adolescents' knowledge and perceptions of opioids and how demographic characteristics affect what information they receive. Furthermore, a limited number of

studies have recruited a nationally representative sample of US adolescents when examining opioid knowledge; rather prior studies have typically recruited a national sample to study adult populations.[7,29] There is a need to understand adolescents' knowledge and perceptions about opioids to create the necessary tools to educate youth on proper opioid use and safety. This study sought to examine adolescents' knowledge and perceptions of opioid use and safety as well as their receptiveness to using an educational game for improving medication safety knowledge.

## 2. Methods

### 2.1. Survey design

Study team members designed a survey that consisted of close-ended questions with "Yes," "No," and "Don't know" options or a five-point Likert scale (Appendix A). The survey collected participants' perceptions on severity and susceptibility of opioid misuse, as well as the use, storage, and disposal of prescription opioids. The survey included questions about participants' attitudes and perspectives regarding opioids and if they thought an educational game would improve their knowledge about opioid medication safety. The survey also collected participants' demographic information, such as age, grade, gender, race, and ethnicity.

Survey questions were adapted from other validated surveys. Questions related to the safe storage and disposal of opioids were modified from a survey assessing the misuse of prescription opioid use within the state of Wisconsin and altered to assess the perceptions and knowledge of misuse, safety, storage, and disposal of prescription opioids in adolescents.[17,30] Questions that involved self-efficacy were adapted from the Medication Understanding and Use Self-Efficacy (MUSE) scale, a validated tool that measures both understanding and self-efficacy in prescription medication use.[31] Questions related to participants' self-efficacy regarding overall medication safety were adapted from a previous study that examined adolescent workplace safety and health knowledge as well as questions related to the participant's behavioral intent regarding prescription opioid use.[32] Questions associated with opioid misuse behaviors were created by the research team and were pilot tested within a study that investigated teens' knowledge and perceptions on prescription opioid misuse.[14] Questions about naloxone knowledge were adapted from a Maryland Opioid Survey Summary Report which examined the public's opinions on prescription opioids—specifically, their perceptions, attitudes, beliefs, and practices.[33]

### 2.2. Recruitment and participants

This study was approved by the University of Wisconsin Institutional Review Board. The survey was open from October to November 2020. A nationally representative sample was recruited via a Qualtrics participant panel. Persons were eligible if they were 12–18 years, lived in the United States, and could speak and understand English. Eligibility was determined (1) from previous studies that examined children's perspectives on medication related topics who were 7–17 years and spoke English,[34,35] (2) from initial community engagement with key stakeholders such as school administrators (principals, health and science teachers, and school nurses) indicating the need to begin opioid education as early

as middle schools and progress into high schools, and (3) because adolescents aged 12–18 years are capable of more complex thinking related to medication use.[36] Thus, adolescents 12–18 years were chosen for the participant age range. Parents of potential participants were screened for eligibility and asked to provide consent for their child to participate in the study and child assent was then obtained. Once both parent and child consented, the parent's contact information was collected. Parents were directed to the online survey for the child to complete independently. A $10 Amazon gift card was emailed to the parent's email address upon completion of the online survey by the child participant.

### 2.3. Data analysis

**2.3.1. Concept scores—**The survey questions were divided into 10 categories to represent key concepts and summarized into concept scores. Five of the concepts consisted entirely of Likert questions with responses graded as five for the most desirable response to one for the least desirable (e.g., strongly agree' to 'strongly disagree'). Survey questions within each of these concepts were summarized by the mean. The remaining five concepts consisted of multiple-choice knowledge questions with one response as correct and the remaining as incorrect. Questions within each of these concepts were summarized by the percent correct responses and range from zero to one.

### 2.4. Categorical analysis

Concept scores were described through means (SD), median [IQR], and range across all participants, stratified by gender (male, female), school (middle school, high school), and race (white non-Hispanic, Black or African American non-Hispanic, Hispanic, and all other groups). Differences between groups were assessed using Kruskal-Wallis tests.

### 2.5. Continuous analysis

The relationship between concept scores and the participant's age were described by the Pearson's correlation coefficient (95% confidence interval) and the linear model coefficient (95% confidence interval) and assessed by the correlation test p-value. Linear models were used to estimate the change in a concept score per year of age. Models were not adjusted for any additional covariates. For concept scores that were statistically significant, the relationship between individual questions and age were assessed using Pearson's correlation tests for Likert questions and Mann-Whitney tests for knowledge questions.

### 2.6. P-value corrections

Significance was assessed at the alpha = 0.05 level. Despite the large number of tests, the analysis was descriptive in nature, so no p-value corrections were made to account for the inflated type 1 error rate. Analysis was conducted using R version 4.0.4.

## 3. Results

Overall, 1261 responses were collected. Of these responses, 659 were unfinished or had missed attention questions and were excluded from data analysis. A total of 602 participants were confirmed to have completed the survey; however, two were found to be duplicates, and eight had international identifiers and were also excluded. The remaining 592 responses

were used for statistical analysis. Descriptions of concept scores excluded four submissions from non-binary participants from analysis by gender.

### 3.1. Demographics

Half of the study participants were female (50%), and the mean age was 14.67 (SD = 1.68). The sample's race/ethnicity mirrored that of the US Census numbers. Characteristics of study participants are shown in Table 1.

### 3.2. Gender

Male participants reported greater perceived knowledge (M = 3.03 (SD = 1.03)) than female participants (2.78 (1.06), p = 0.003). Female participants scored greater on the misuse harm scale (4.34 (0.75)) than male participants (4.22 (0.82), p = 0.044). Male participants scored higher on the opioid knowledge scale (0.87 (0.17)) than female participants (0.84 (0.18), p = 0.048) as shown in Table 2.

### 3.3. School

High school students scored higher on the opioid knowledge scale (0.87 (0.15)) than middle school students (0.82 (0.21), p = 0.046).

### 3.4. Race

Comparisons between participants identifying as White or Caucasian, Black or African American, Hispanic or Latinx, and those identifying as any other group are shown in Table 2. Overall, participants identifying as White or Caucasian reported higher rates of perceived opioid knowledge, behavioral intent, safe medication disposal, and overall opioid knowledge than those who identified as African American, Hispanic or Latinx, or any other group.

### 3.5. Age

Misuse harm (rho = 0.10, 95% CI 0.02 to 0.18, p = 0.013), perceived knowledge (rho = 0.11, 95% CI 0.03 to 0.19, p = 0.007), and opioid knowledge (rho = 0.13, 95% CI 0.05 to 0.21, p = 0.001) were positively associated with age.

### 3.6. Opioid perceptions and educational intervention

Most participants (78%) stated the opioid crisis was harming teenagers in the United States and 83.1% recognized it was not proper to take someone else's opioid medication if you have had the same prescription in the past. When participants were asked if they had heard of the drug naloxone (Narcan®), 290 (49%) reported "yes" and of those 290 respondents, 221 (76.2%) recognized that it was used to reverse opioid overdoses. Additionally, when participants were asked "after playing an educational video game, would you feel as though your knowledge about opioid medication safety would increase?" 80% reported "yes" (Table 3).

## 4. Discussion

In this study, a nationally representative sample of adolescents were recruited, and an online survey was used to quantitatively measure their knowledge and perceptions on opioid use, storage, and disposal, as well as their receptivity for the use of an educational game to increase opioid knowledge. There was a difference in knowledge for opioid use and safety among genders, race, level in school, and age, which is consistent with current literature.[19,20,22] Additionally, participants stated that playing an educational game would increase their knowledge about opioid medication safety.

Racial/ethnic minorities and underserved populations are underrepresented in medical literature, and there is a need to explore their knowledge, understanding, and experiences regarding opioid use and safety.[6,16,19–21] This study sought to contribute to this need by recruiting a nationally representative sample of adolescents. Results showed female participants scored greater on the misuse harm scale than male participants, which is in line with existing literature.[37] White or Caucasian participants reported higher rates of perceived opioid knowledge, behavioral intent, safe medication disposal, and opioid knowledge than those who identified as African American, Hispanic or Latinx, or any other group. Additionally, misuse harm, perceived knowledge, and opioid knowledge were positively associated with age. Results showed female participants scored greater on the misuse harm scale than male participants, which is in line with existing literature.[37] Findings suggest opportunities for accessible health education to provide adolescents, especially minorities, with information about opioid use, overdose reversal, and disposal options. Results from this study also support the use of an educational game to increase adolescents' opioid knowledge. An education game may serve as an engaging and interactive approach for parents, healthcare professionals, or schoolteachers to educate youth on prescription opioid safety when these medications are prescribed in clinics and dispensed pharmacies.

Previous literature suggests that factors such as family members, peers, and healthcare professional influence can increase the risk of opioid misuse and should be addressed when designing an educational game.[38] There is a strong association between parents who misuse opioids and their adolescent misusing opioids, both intentionally and accidently; one-third of adolescents who misuse opioids report a family member as the source of the drug.[39] Additionally, studies show parents want to help their children relieve pain, even if that means giving them opioids in greater doses or frequency.[40] Moreover, there is a significant correlation between lifetime opioid dependence and having a prescription opioid in the household medicine cabinet.[41] Approximately 85% of adolescents report getting opioids from family members who incorrectly stored prescribed medications.[42] Studies also found proper storage of opioids is more common in households with children under the age of seven, even though adolescents are more likely to misuse opioids and share them with others.[27,43–45] Hence, an educational game should address these common issues related to responsible opioid use in homes and appropriate storage and disposal mechanisms.

Future studies should create and investigate the use of an educational game that allows both the adolescent and their parent to learn about safe opioid use. Based on the results from this study, educational content needs to focus on opioid knowledge, opioid misuse,

behavioral intent, medication disposal, and naloxone (Narcan®) use. Researchers should obtain feedback from adolescents, in the form of surveys and focus groups, on what they would like to see in an educational game designed for medication safety as well as professionals' perspectives on how to implement an educational game for use in homes with youth and adoption by healthcare and school settings. The educational game would need to be designed to connect with a diverse audience and with potential for use in schools as part of health or science classes, and in healthcare settings such as clinics and pharmacies where adolescents are prescribed and dispensed opioids medications.

### 4.1. Limitations

This study relied on the use of self-report to collect information and trusted participants to give honest responses. Such study designs are limited by forgetfulness, dishonesty, fraud, and reporting-bias. This study design also relied on trusting the parent to allow their child to fill out the survey, on their own, and not influence their responses. To ensure accuracy, another national survey should be distributed in a way that confirms adolescents are the ones taking the survey and their parents are not influencing their responses. Furthermore, a focus group or interview could be incorporated, especially when asking the question "After playing an educational video game, would you feel as though your knowledge about opioid medication safety would increase?" so participants could elaborate on their responses and what they would like to see in the educational game.

### 4.2. Implications for pharmacy practice

The Pediatric Pharmacy Advocacy Group recommends pharmacists educate adolescents and their families about proper administration, storage, and disposal of opioids and when to prescribe naloxone (Narcan®).[46] Pharmacists can play a critical role in reducing the number of opioid misuse cases each year by adolescents through empowering parents to talk with their children about prescription opioid use and medication safety. Given that adolescents report parents as useful resources for information about opioid safety, especially mothers, a clear opportunity exists to positively impact family communication and practices around opioid safety in a pharmacy setting.[47] Thus, a family-driven intervention is essential.

Educational video games have been successful in effecting behavior change and other health-related issues for adolescents.[48] A novel and engaging educational game can be used as an interactive tool to promote and facilitate parent-child conversations about prescription opioid medication safety. Availability of the game during dispensing of opioid medications to families with children in pharmacies where the pharmacist is present will allow pharmacists to foster conversations with their adolescent patients and family members. The game may also prompt parents and children to ask pharmacists' medication-related questions they may not have thought about before playing the game, such as how to correctly store and dispose of opioid medications.

## 5. Conclusion

This study assessed adolescents' opioid knowledge and the likelihood of an educational game to promote medication safety. Results showed a difference in knowledge for opioid

use and safety among genders, race, school level, and age. Findings support the use of an educational game to increase adolescent's opioid knowledge. An educational game that incorporates adolescents' family members, peers, and healthcare professionals' feedback is essential to decreasing the number of adolescents who report misusing opioids each year. Future studies should investigate the use of an educational game to educate adolescents on opioid use, safety, storage, disposal, and how to reverse an opioid overdose.

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## Data statement

Due to the sensitive nature of the questions asked in this study, survey respondents were assured raw data would remain confidential and would not be shared.

## Appendix A.: The 67-item survey with questions, concepts, and response types.

| Question | Concept | Response Type |
|---|---|---|
| Can opioid medications make you dizzy or sleepy even when they are taken as prescribed by your doctor?<br>If you do not know how much of an opioid medication to take, is it ok to ask your friends?<br>Can taking too much of an opioid medication cause you to pass out?<br>Is it safe to drive a car or supervise children after you have taken your prescribed amount of opioid medication?<br>Is constipation a sign of opioid medication dependence or addiction?<br>Can opioid medications cause harm when not used as prescribed by your doctor?<br>Can extra opioid medications be shared with your friends if they are in pain?<br>If you take an opioid medication correctly, can there still be side effects?<br>Is the opioid crisis harming teenagers in the U.S.? | Opioid knowledge | Yes; No; Don't know |
| Should prescription opioids be stored … in the medicine cabinet?<br>Should prescription opioids be stored … in an unlocked drawer or cabinet?<br>Should prescription opioids be stored … in a purse or handbag?<br>Should prescription opioids be stored … in a locked place, such as a lock box, safe, or locked drawer? | Safe Storage | |
| Should you get rid of unused prescription opioids by … throwing them in the trash?<br>Should you get rid of unused prescription opioids by … dropping them off in a disposal box?<br>Should you get rid of unused prescription opioids by … flushing them down the toilet?<br>Should you get rid of unused prescription opioids by … putting them in cat litter or coffee grinds?<br>Should you get rid of unused prescription opioids by … taking them to a | Safe Disposal | |

| Question | Concept | Response Type |
|---|---|---|
| pharmacy, doctor, or hospital?<br>Should you get rid of unused prescription opioids by … putting them down the sink/disposal? | | |
| How much do you know about … how to use an opioid medication safely?<br>How much do you know about … what counts as misuse of an opioid medication?<br>How much do you know about … the harmful effects of misusing opioids?<br>How much do you know about … how to store opioids safely?<br>How much do you know about … what you should do in situations involving an opioid overdose?<br>How much do you know about … how to dispose of opioids safely? | Perceived knowledge | Likert: 1, none; 2, a little; 3, some; 4, quite a bit; 5, a great deal |
| It is easy for me to ask my parent questions about safe opioid use.<br>It is easy for me to understand my parent's instructions for using opioids safely.<br>It is easy for me to understand instructions on how to safely manage opioids.<br>It is easy for me to get all the information I need about safe opioid use. | Self-Efficacy: MUSE | Agreement scale: 1, strongly disagree; 2, slightly disagree; 3, neutral; 4, slightly agree; 5, strongly agree |
| How confident are you that you can …<br>use opioid medication as directed?<br>know where your medication is at all times?<br>store your medication in a locked area?<br>dispose of your medication in a drop box?<br>tell a friend no if they ask to share your medication?<br>only take medication that was prescribed for you?<br>encourage others to use opioids safely? | Self-Efficacy: learning objectives | Confidence scale: 1, not at all confident; 2, slightly; 3, somewhat; 4, very; 5, extremely confident |
| How much harm does misuse of opioids do to a person's … physical health?<br>How much harm does misuse of opioids do to a person's … mental health?<br>How much harm does misuse of opioids do to a person's … ability to do well in school?<br>How much harm does misuse of opioids do to a person's … relationships with their family?<br>How much harm does misuse of opioids do to a person's … relationships with their peers or friends? | Misuse harm | Likert: 1, none; 2, a little; 3, some; 4, quite a bit; 5, a great deal |
| Is someone misusing opioids if … they return their unused opioid medication to the pharmacy when it expires?<br>Is someone misusing opioids if … they use their prescribed opioid after it expires?<br>Is someone misusing opioids if … they use someone else's opioid medication?<br>Is someone misusing opioids if … they use opioids more often than their prescription calls for?<br>Is someone misusing opioids if … they share their opioid medications with others?<br>Is someone misusing opioids if … they take their opioid medication for a reason different than what it was prescribed for?<br>Is it okay to take someone else's opioid medication if you have had the same prescription in the past? | Misuse behavior | Yes; No; Don't know |
| Have you heard of the drug naloxone (Narcan)?<br>(if yes) Is Naloxone (Narcan) used to … reverse only heroin overdoses?<br>(if yes) Is Naloxone (Narcan) used to … help heroin users detox?<br>(if yes) Is Naloxone (Narcan) used to … reverse any opioid overdose? | Narcan knowledge | Yes; No,<br>If 'Yes' to first question, then 'Yes; No; Don't know' to additional questions. |
| How likely are you to do the following?<br>use opioid medication as directed?<br>know where my medication is at all times?<br>store my medication in a locked area?<br>dispose of my medication in a drop box?<br>share my medication with a friend in need?<br>take medication that was prescribed for someone else?<br>encourage others to use opioids safely? | Behavioral intent | Likelihood scale: 1, not at all; 2, slightly; 3, somewhat; 4, very; 5, extremely likely |
| After playing an educational video game, would you feel as though your knowledge about opioid medication safety would increase? | Perceived game effect | Yes; No |

| Question | Concept | Response Type |
|---|---|---|
| Please select “a great deal.” This question is to make sure you are still paying attention.<br>This is to make sure you are still paying attention. Please select “somewhat.” | Attention check | As directed in the question |
| Year in school -<br>Gender<br>Age | Demographics | 7th - 12th grade<br>1, Female; 2, Male; 3, Transgender; 4, Nonbinary; 5, Other<br>12–18 years old |
| How many kids under 18 live in your household? Do not count yourself. | | Insert Number |
| Race/ethnicity | | 1, American Indian or Alaskan Native; 2, Asian; 3, Black or African American; 4, Hispanic or Latinx; 5, Native Hawaiian or Other Pacific Islander; 6, White or Caucasian; 7, Other: Please specify |

## Abbreviations:

| | |
|---|---|
| **CDC** | The Centers for Disease Control and Prevention |
| **MUSE** | Medication Understanding and Use Self-Efficacy scale |

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## Table 1

Participant demographic characteristics.

| **Grade**[a] | **n (%)** |
|---|---|
| 7th | 96 (16) |
| 8th | 95 (16) |
| 9th | 123 (21) |
| 10th | 104 (18) |
| 11th | 82 (14) |
| 12th | 89 (15) |
| **Age, years** | |
| Mean (SD) | 14.67 (1.68) |
| **Number of household members under the age of 18 years** [c] | |
| 0 | 142 |
| 1 | 227 |
| 2 | 155 |
| 3 or more | 66 |
| Did not answer | 2 |
| Mean (SD) | 1.31 (1.13) |
| **Gender** [b] | |
| Female | 296 (50) |
| Male | 292 (49.32) |
| Nonbinary | 4 (0.68) |
| **Race/Ethnicity** [a] | |
| White or Caucasian | 342 (57.77) |
| Black or African American | 90 (15.2) |
| Hispanic or Latinx | 46 (7.77) |
| Asian | 26 (4.39) |
| American Indian or Alaskan native | 6 (1.01) |
| Native Hawaiian or Other Pacific Islander | 1 (0.17) |
| More than one selected | 76 (12.84) |
| Other please specify | 3 (0.51) |

[a]Responses to demographic questions were requested but not required. Missing status indicates participants did not answer the demographic question.

[b]Due to the small sample size, responses of ‘nonbinary’ were excluded from analysis examining the effects of gender, with a total of 588 used instead of 592.

[c]If the participant lived in more than one home, they were asked to answer regarding the home they spent the most time in. The participant was asked to not include themselves in the total number of people living in their home under the age of 18.

**Table 2**

Concept scores amongst participants.

| Variable | Self-efficacy: MUSE | Self-efficacy: Learning Objectives | Perceived Knowledge | Misuse Harm | Behavioral Intent | Safe Storage | Safe Disposal | Opioid Knowledge | Narcan® Knowledge | Misuse Behavior |
|---|---|---|---|---|---|---|---|---|---|---|
| **Overall** | | | | | | | | | | |
| N | 592 | 592 | 592 | 591 | 592 | 592 | 592 | 592 | 290 | 592 |
| Mean (SD) | 4.29 (0.77) | 3.98 (0.79) | 2.90 (1.05) | 4.28 (0.80) | 3.38 (0.64) | 0.92 (0.19) | 0.88 (0.20) | 0.85 (0.18) | 0.79 (0.31) | 0.62 (0.29) |
| **Gender** | | | | | | | | | | |
| Female, mean (SD) | 4.35 (0.72) | 4.00 (0.80) | **2.78 (1.06)** | **4.34 (0.75)** | 3.39 (0.62) | 0.92 (0.19) | 0.87 (0.21) | **0.84 (0.18)** | 0.79 (0.31) | 0.62 (0.28) |
| Male, mean (SD) | 4.23 (0.81) | 3.95 (0.78) | **3.03 (1.03)** | **4.22 (0.82)** | 3.38 (0.66) | 0.92 (0.19) | 0.89 (0.18) | **0.87 (0.17)** | 0.80 (0.31) | 0.61 (0.30) |
| Kruskal-Wallis p-value | 0.105 | 0.299 | **0.003** | **0.044** | 0.752 | 0.972 | 0.139 | **0.048** | 0.503 | 0.755 |
| **Race** | | | | | | | | | | |
| White or Caucasian, mean (SD) | 4.34 (0.73) | 4.01 (0.76) | **3.14 (1.00)** | 4.25 (0.76) | **3.44 (0.63)** | 0.93 (0.16) | **0.90 (0.18)** | **0.88 (0.16)** | 0.81 (0.30) | 0.63 (0.28) |
| Black or African American, mean (SD) | 4.25 (0.81) | 4.03 (0.82) | **2.78 (1.02)** | 4.38 (0.78) | **3.40 (0.59)** | 0.94 (0.18) | **0.88 (0.20)** | **0.86 (0.18)** | 0.79 (0.31) | 0.63 (0.30) |
| Hispanic or Latinx, mean (SD) | 4.24 (0.81) | 3.95 (0.78) | **2.60 (1.11)** | 4.23 (0.94) | **3.30 (0.67)** | 0.88 (0.26) | **0.84 (0.24)** | **0.80 (0.23)** | 0.73 (0.35) | 0.59 (0.31) |
| Other or missing, mean (SD) | 4.15 (0.80) | 3.78 (0.90) | **2.23 (0.83)** | 4.34 (0.77) | **3.12 (0.63)** | 0.92 (0.20) | **0.85 (0.24)** | **0.80 (0.17)** | 0.74 (0.32) | 0.61 (0.31) |
| Kruskal-Wallis p-value | 0.306 | 0.282 | < **0.001** | 0.213 | **0.005** | 0.426 | **0.049** | < **0.001** | 0.432 | 0.767 |
| **School** | | | | | | | | | | |
| High school, mean (SD) | 4.30 (0.77) | 4.00 (0.80) | 2.96 (1.05) | 4.32 (0.77) | 3.39 (0.62) | 0.92 (0.20) | 0.88 (0.20) | 0.87 (0.15) | 0.81 (0.30) | 0.62 (0.29) |
| Middle school, mean (SD) | 4.28 (0.77) | 3.93 (0.77) | 2.79 (1.03) | 4.20 (0.86) | 3.36 (0.69) | 0.93 (0.16) | 0.88 (0.20) | 0.82 (0.21) | 0.76 (0.33) | 0.62 (0.29) |
| Kruskal-Wallis p-value | 0.584 | 0.228 | 0.066 | 0.155 | 0.369 | 0.901 | 0.599 | 0.046 | 0.286 | 0.923 |
| **Grade** | | | | | | | | | | |
| Correlation coefficient | 0.05 | 0.06 | **0.1** | **0.09** | 0.05 | 0.01 | 0.03 | **0.13** | 0 | 0.01 |
| 95% CI | −0.03 to 0.13 | −0.02 to 0.14 | **0.02 to 0.18** | **0.01 to 0.17** | −0.03 to 0.13 | −0.08 to 0.09 | −0.05 to 0.11 | **0.05 to 0.21** | −0.11 to 0.12 | −0.07 to 0.09 |

| Variable | Self-efficacy: MUSE | Self-efficacy: Learning Objectives | Perceived Knowledge | Misuse Harm | Behavioral Intent | Safe Storage | Safe Disposal | Opioid Knowledge | Narcan® Knowledge | Misuse Behavior |
|---|---|---|---|---|---|---|---|---|---|---|
| Pearson's correlation p-value | 0.21 | 0.142 | **0.011** | **0.03** | 0.224 | 0.89 | 0.473 | **0.001** | 0.956 | 0.775 |
| **Age** | | | | | | | | | | |
| Correlation coefficient | 0.05 | 0.06 | **0.11** | **0.1** | 0.07 | 0.02 | 0.06 | **0.13** | 0.05 | 0.03 |
| 95% CI | −0.03 to 0.13 | −0.02 to 0.14 | **0.03 to 0.19** | **0.02 to 0.18** | −0.01 to 0.15 | −0.06 to 0.10 | −0.02 to 0.14 | **0.05 to 0.21** | −0.07 to 0.16 | −0.05 to 0.11 |
| Pearson's correlation p-value | 0.214 | 0.132 | **0.007** | **0.013** | 0.102 | 0.637 | 0.142 | **0.001** | 0.438 | 0.415 |

[a]Bolded values indicate significant findings.

## Table 3

Survey questions of significance within key concepts.

| Question | Response (N, Percent) | | |
|---|---|---|---|
| | Yes | No | Don't Know |
| Is the opioid crisis harming teenagers in the U.S.?[a] | | | |
| | 462 (78%) | 31 (5%) | 99 (17%) |
| **After playing an educational video game, would you feel as though your knowledge about opioid medication safety would increase?** | | | |
| | 471 (80%) | 121 (20%) | |
| **Is it okay to take someone else's opioid medication if you have had the same prescription in the past?** [b] | | | |
| | 66 (11.1%) | 492 (83.1%) | 34 (5.7%) |
| **Have you heard of the drug naloxone (Narcan®)?** | | | |
| 290 (49%) | | 302 (51%) | |

[a]The correct answer to this question is "yes".

[b]The correct answer to this question is "no".