



Youth and young adult knowledge of and access to opioid harm reduction policies and interventions in North Carolina

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HIGHLIGHTS

- Most youth and young adults who used substances were aware of the Good Samaritan Law.
- 80.0 % of youth and young adults who used substances were aware of naloxone.
- Only 43.0 % perceived they had access to naloxone.
- About three-quarters of youth and young adults were aware of fentanyl test strips.
- Only 21.9 % perceived they had access to fentanyl test strips.

ARTICLE INFO

Keywords:

Harm reduction
Naloxone
Good samaritan law
Test strips
Youth
Young adult

ABSTRACT

Introduction: From 2019–2021, overdose deaths among youth and young adults ages 10–19 years of age residing in the United States increased by 109 %. We sought to examine the extent to which youth and young adults who have experience with substance use are aware of the harm reduction policies and interventions, including the statewide Good Samaritan Law (GSL), naloxone, and fentanyl test strips, and have access to naloxone and fentanyl test strips.

Methods: From December 2022 to February 2023, we conducted a cross-sectional telephone survey of individuals ages 12–25 years who resided in North Carolina (NC) (N=15,000). We assessed awareness of and access to harm reduction policies and interventions among participants who reported ever using heroin/fentanyl, diverted prescription medication, cocaine, methamphetamine, and hallucinogens (n=539). Logistic regression models were used to identify factors associated with awareness of and access to these policies and interventions.

Results: We found that 81.5 % of the sample of youth and young adults who reported ever use of substances were aware of NC's GSL, 80.0 % were aware of naloxone, 43.0 % perceived they had access to naloxone, 74.4 % were aware of fentanyl test strips, and 21.9 % perceived they had access to fentanyl test strips. There were individual and community-level characteristics associated with awareness of and perceived access to these harm reduction policies and interventions.

Conclusions: Efforts are needed to improve access to harm reduction interventions among youth and young adults as they are experiencing an increased risk of dying from opioid-involved overdoses.

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<https://doi.org/10.1016/j.dadr.2024.100265>

Received 20 March 2024; Received in revised form 22 July 2024; Accepted 24 July 2024

Available online 30 July 2024

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1. Introduction

Youth and young adults (YYA) ages 10–19 years of age residing in the United States (US) are at increased risk of experiencing an opioid-involved drug overdose. From 2019–2021, the median monthly overdose deaths among YYAs increased 109 % which exceeds the overall percentage increase in total overdose deaths in the US (Tanz, 2022). This increase in overdose deaths among this population was partly due to illicitly manufactured fentanyl as deaths involving fentanyl increased by 182 % (Tanz, 2022). Most deaths occurred in the individual's home (60.4 %) with a bystander present (66.9 %). Naloxone, an opioid-antagonist designed to reverse overdoses involving opioids, was only administered by a bystander in 30.3 % of deaths, and over half (59.4 %) of individuals did not have a pulse when first responders arrived indicating provision of naloxone by the first responder would be ineffective (Tanz, 2022). Harm reduction messaging and interventions need to reach YYAs to prevent opioid-involved deaths (Alcocer, 2023; Chadi and Hadland, 2019; Kimmel et al., 2021; Tanz, 2022).

Three ways in which YYAs can engage in harm reduction activities, include calling 911 in the event of an overdose, administering naloxone to someone who has overdosed, and testing substances for the presence of fentanyl before choosing to use them. Fear of arrest or prosecution is a common barrier to bystanders calling 911 in the event of an overdose. Comprehensive Good Samaritan Laws (GSL) provide immunity from arrest, charge, or prosecution for a person who is experiencing or witnessing an overdose and summons emergency services (McClellan et al., 2018; Moallem and Hayashi, 2021). As of May 2023, 48 states in the US have adopted an overdose GSL (Truong, 2023) and some countries, such as Canada, have national Good Samaritan policies (Government of Canada, 2021). Access to take-home naloxone has been expanding in the US and other countries through syringe services programs, standing orders at pharmacies (i.e., the pharmacy can dispense naloxone without a prescription), and, most recently, over-the-counter naloxone at pharmacies. Rapid test strips are a form of drug-checking equipment that allows individuals to check their drug supply for fentanyl or fentanyl analogs before use. As of August 2023, forty-five states in the US permit the possession of fentanyl test strips (Network for Public Health Law, 2023). Adults who use drugs have shared that they find fentanyl test strips to be practical and easy to use (Reed et al., 2022) and that they change their drug use behavior if they get a positive result (Peiper et al., 2019). Several studies have examined perceptions and use of naloxone and fentanyl test strips among young adults who are unhoused and/or engaged with syringe services programs (Calvo et al., 2017; Goldman et al., 2019; Goldman-Hasbun et al., 2017; Krieger et al., 2018a, 2018b; Mitchell et al., 2017; Noyes et al., 2022)(Calvo et al., 2017; Goldman-Hasbun et al., 2017; Mitchell et al., 2017; Noyes et al., 2022). However, little is known about the extent to which YYAs who may not be unhoused or engaging with syringe services programs, but who are nonetheless at risk of experiencing or witnessing an overdose, are aware of or have access to these harm reduction strategies.

The state of North Carolina (NC) has been heavily impacted by the opioid crisis. The most recent age-adjusted drug overdose death rate is 39.2 per 100,000 total population which exceeds the median rate of 31.5 per 100,000 total population in the US (CDC, 2022). NC has had a GSL since 2013 (Hoban, 2023), a statewide standing order for naloxone since 2016 (Pate et al., 2016), and permits the possession of fentanyl test strips (Network for Public Health Law, 2023). The objective of the present study was to examine the extent to which YYAs ages 12–25 years in NC who have experience using substances that may put them at higher risk of overdose either due to intentional use of an opioid or a substance that may be contaminated with fentanyl (i.e., heroin/fentanyl, diverted prescription medications, cocaine, methamphetamine, hallucinogens; (CDC, 2024; Cruz et al., 2023; Wagner et al., 2023) are aware of and have access to harm reduction policies and interventions aimed at preventing opioid overdose. We assessed awareness of NC's GSL and awareness of and access to naloxone and fentanyl test strips.

2. Methods

2.1. Study design

From December 2022 to February 2023, we conducted a cross-sectional telephone survey of YYAs ages 12–25 years (N=15,000) who resided in NC to assess substance use behaviors, attitudes, and experiences. We followed the guidelines for reporting observational studies set forth by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement (von Elm et al., 2007). Procedures were reviewed and approved by the Wake Forest University School of Medicine Institutional Review Board (IRB) before study initiation (IRB00085540).

2.2. Participant recruitment and procedures

We worked with Qualtrics® to conduct the telephone survey. Qualtrics® identified potential participants who met the eligibility criteria for our study from their database of compiled panels and invited potential participants to participate in a telephone interview. Before beginning the telephone interview, verbal consent was obtained from participants; a waiver of parental consent for youth 17 years was approved by the IRB. The interviews were conducted by trained interviewers. Interviewers recorded participants' responses to the survey questions on Qualtrics®'s secure platform. It took on average 29 minutes to complete a survey. Participants received incentives through their Qualtrics® rewards accounts worth the equivalent of \$25.

To be eligible to participate in this survey, each participant had to be an NC resident and between 12 and 25 years of age. We set quotas on age (i.e., 12–18 and 19–25) and geographic residence based on 25 regions across NC. Considering these two quotas, we aimed to recruit 300 participants within each age group for each of the 25 regions, resulting in a total sample of 15,000 YYAs ages 12–25 years of age. We successfully obtained our quotas and received responses from YYAs residing in 99 out of 100 counties in NC. Weighting for unequal probabilities of inclusion and post-stratification using NC Census Data was employed to generalize to the state level and better align our observed sample with the NC population of YYAs 12–25 years old.

2.3. Measures

2.3.1. Dependent variables

Our dependent variables were awareness of NC's GSL, awareness and access to naloxone, and awareness and access to fentanyl test strips. Awareness of NC's GSL was assessed with the following yes or no question: 'The NC 911 Good Samaritan Laws states that individuals who experience a drug overdose or persons who witness an overdose and seek help for the victim can no longer be prosecuted for possession of small amounts of drugs, paraphernalia, or underage drinking. Prior to this survey, had you heard of the NC 911 Good Samaritan Law?'. We examined awareness of and access to naloxone with a single question and three response options: 'Naloxone is a prescription medicine used to treat a known or suspected opioid (i.e., prescription pain medicine, heroin, fentanyl) overdose. Which of the following describes your knowledge, prior to this survey, and access to naloxone, sometimes called Narcan... (1) I know what naloxone is and have access to it, (2) I know what naloxone is and do not have access to it, (3) I do not know what naloxone is'. Awareness of and access to fentanyl test strips were examined with a single question and three response options: 'Fentanyl test strips can be used to identify the presence of fentanyl in drugs. Which of the following describes your knowledge, prior to this survey, and access to fentanyl test strips... (1) I know what fentanyl test strips are and have access to them, (2) I know what fentanyl test strips are and do not have access to them, (3) I do not know what fentanyl test strips are'.

2.3.2. Sociodemographic variables

We examined age (ranging from 12 to 25; treated as a continuous variable), biological sex (coded as male or female), and race and ethnicity (coded as non-Hispanic-Asian, non-Hispanic-Black, Hispanic, non-Hispanic White, and Other Race). Other Race consisted of individuals who identified as Hawaiian, American Indian, or Middle Eastern. We assessed whether the participant was enrolled in school or college and, if so, what type of school (coded as elementary/middle, high school, 2-year college, 4-year college, and not currently enrolled in school/college). Perceived mental health status was queried by asking 'in general, how is your mental health?'. Response options were on a 5-point scale ranging from excellent to poor with a higher score indicating poorer mental health. Perceived peer nonmedical use of prescription medications was assessed by asking 'How many of your friends do you think use prescription medications not prescribed to them?'. Response options were on a 5-point scale ranging from none to all with a higher score indicating a greater percentage of friends engaging in nonmedical prescription medicine use.

2.3.3. Community-level variables

We examined urbanicity (coded as rural (250 people per square mile or less), suburban (250–750 people per square mile), and urban (more than 750 people per square mile)), population density (population/square mile), median household income, and the percentage of minority residents 12–18 years of age (U.S. Census Bureau, 2020). We also examined county distress defined by NC's Department of Commerce (coded as Tier 1-Tier 3). The NC Department of Commerce calculates the county distress rankings based on the average unemployment rate, median household income, percentage growth in population, and adjusted property tax base per capita. Tier 1 counties are the most distressed and Tier 3 counties are the least distressed (North Carolina Department of Commerce, 2021).

2.4. Data analysis

The analytic sample for this study was restricted to participants who reported ever use of heroin/fentanyl, prescription medication, cocaine, methamphetamine, or hallucinogens, ($n=539$). Descriptive statistics were used to describe the sample and outcome measures. For the latter, 95 % Wilson confidence intervals (CIs) were additionally estimated. For multivariable modeling, logistic regression was performed for each dichotomous outcome measure with robust sandwich standard errors. Adjusted odds ratios (AORs) and their 95 % CIs were estimated for individual-level and community-level characteristics in the modeling. Multicollinearity was assessed with variance inflation factors (VIFs) and eigenanalysis (Muller and Fetterman, 2002) and no collinearity issues were present (e.g., all VIFs < 3.5). All analyses were performed using SAS v9.4 (SAS Institute, Cary, NC). A two-sided p -value < 0.05 was considered statistically significant.

3. Results

3.1. Sample characteristics

Among our analytic sample of 539 YYAs who reported ever use of heroin/fentanyl, diverted prescription medication, cocaine, methamphetamine, or hallucinogens, the mean age was 21.9 ($SD=2.7$); 32.9 % identified as female; 70.7 % identified as non-Hispanic White; and 0.9 % were enrolled in elementary/middle school, 11.3 % in high school, 43.2 % in college, and 44.5 % not in school/college.

3.2. Awareness of and access to opioid harm reduction policies and interventions

Most (81.5 %) YYAs had heard of NC's GSL (Table 1). Over three-quarters (80.0 %) of YYAs were aware of naloxone and just under half

(43.0 %) of YYAs reported having access to naloxone (Table 2). About three-quarters (74.4 %) reported awareness of fentanyl test strips, and only 21.9 % of YYAs reported having access to fentanyl test strips (Table 3). There were statistically significant associations between individual-level characteristics and awareness of and access to opioid harm reduction policies and interventions. No community-level characteristics were statistically significant with awareness, but several were related to perceived access to naloxone. The relationship between individual and community-level characteristics and awareness of and access to opioid harm reduction policies and interventions are reported in Tables 1–3.

4. Discussion

We examined the extent to which YYAs ages 12–25 years who have experience with substance use are aware of and have access to harm reduction interventions and policies aimed at preventing opioid overdose. A large proportion of YYAs who had experience with substance use were aware of NC's GSL, naloxone, and fentanyl test strips. However, only 43 % perceived that they had access to naloxone and 22 % to fentanyl test strips.

While awareness of the GSL, naloxone, and fentanyl test strips was relatively high, it is unknown if YYA have accurate knowledge of these harm reduction strategies. For example, a mixed methods study of YYAs conducted in British Columbia found that YYAs overestimated protections from GSLs (Ackermann et al., 2022). Further, YYAs may have multiple Good Samaritan policies with differential consequences to navigate based on the contexts in which they interact. For YYAs enrolled in school, their academic institution may or may not have a Good Samaritan policy (Salmassi, 2023). Further, a growing number of high schools in the US have started implementing overdose education and providing naloxone to school staff members (KFF Health News, 2023; Levasseur et al., 2020). Post secondary institutions have also started implementing naloxone and fentanyl test strip distribution programs (Alonso, 2023; Knox, 2022; Panther et al., 2017; Schlemmer, 2023; Wagner et al., 2022) increasing the likelihood of knowledge and perceived access to among young adults enrolled at these institutions. Our findings suggest that exposure to academic institutional policies and resources may increase awareness of – and access to resources such as naloxone and fentanyl test strips. We found that YYAs enrolled in elementary/middle and high school were more likely to be aware of NC's GSL than those not currently enrolled in school who were not currently enrolled. Further, those enrolled in high school or a 4-year post secondary institution were more likely than those not currently enrolled in school to know about naloxone and fentanyl test strips and perceive they had access to naloxone, but there was no difference for perceived access to fentanyl test strips.

We found that YYAs who were at increased risk of opioid use and associated harms, based on their mental health status and peer affiliation groups, were more likely to be aware of and perceive access to harm reduction policies and interventions. Given that YYAs with a documented mental health history (e.g., depression, self-harm behaviors, and engagement in mental health treatment) are at heightened risk of experiencing an overdose (Tanz, 2022), it is promising that participants in our sample with poorer mental health were more likely to know about the NC GSL and be aware of and have access to naloxone and fentanyl test strips. Perceived peer use of substances has been associated with an increased likelihood of engaging in the same substance use behavior (Aas and Klepp, 1992; Egan et al., 2019; Elek et al., 2006; Perkins and Berkowitz, 1986). Further, individuals who had friends who misuse prescription medications were more aware of the NC GSL, naloxone, and fentanyl test strips and were more likely to perceive that they had access to naloxone and fentanyl test strips. The heightened awareness and perceived access to harm reduction strategies may be a result of exposure to counseling or other programs for mental health needs or from conversations with their peers who engage in substance use behaviors.

Table 1
Awareness of Good Samaritan Law (GSL) among NC youth and young adults.

	Overall	Knows about GSL	Does not know about GSL	Knowledge about GSL (Yes vs No)
	<i>n</i> (%) or <i>M</i> ± <i>SD</i>	<i>n</i> (%) or <i>M</i> ± <i>SD</i>	<i>n</i> (%) or <i>M</i> ± <i>SD</i>	AOR (95 % CI)
Overall	539 (100)	439 (81.5)	100 (18.6)	-
Sociodemographic characteristics				
Age in years	21.9 ± 2.7 (range: 12–25)	22.3 ± 2.6 (range: 12–25)	20.5 ± 2.9 (range: 12–25)	1.53*** (1.29, 1.82)
Biological sex				
Female	177 (32.8)	139 (31.7)	38 (38.0)	0.96 (0.58, 1.61)
Male ^{RC}	361 (67.0)	299 (68.1)	62 (62.0)	-
missing	1 (0.2)	1 (0.2)	0	-
Race/Ethnicity				(<i>df</i> =2) 0.3510
Black	106 (19.7)	83 (18.9)	23 (23.0)	0.76 (0.43, 1.35)
Other Race	52 (9.7)	43 (9.8)	9 (9.0)	1.39 (0.60, 3.20)
White ^{RC}	381 (70.7)	313 (71.3)	68 (68.0)	-
Mental health (range = 0–4) ^a	2.1 ± 1.3	2.0 ± 1.3	2.6 ± 1.4	0.71** (0.58, 0.87)
Enrolled in				(<i>df</i> =4) 0.2499
Elementary/Middle	5 (0.9)	3 (0.7)	2 (2.0)	19.6* (1.16, 331.6)
High School	61 (11.3)	39 (8.9)	22 (22.0)	4.06* (1.04, 15.8)
2 yr. College	10 (1.9)	9 (2.1)	1 (1.0)	3.86 (0.31, 48.0)
4 yr. College/Graduate	223 (41.4)	182 (41.5)	41 (41.0)	1.79 (0.89, 3.59)
Not in school/college ^{RC}	240 (44.5)	206 (46.9)	34 (34.0)	-
Peer use Rx meds (range = 0–4) ^b	1.2 ± 0.8	1.2 ± 0.8	1.1 ± 0.9	1.00 (0.73, 1.38)
Community characteristics				
Urbanicity				(<i>df</i> =2) 0.7979
Rural	202 (37.5)	163 (37.1)	39 (39.0)	1.39 (0.49, 3.90)
Suburban	210 (39.0)	171 (39.0)	39 (39.0)	1.10 (0.53, 2.29)
Urban ^{RC}	127 (23.6)	105 (23.9)	22 (22.0)	-
Population density (pop/sq.mi)	519.9 ± 557.7	524.5 ± 561.7	499.7 ± 542.3	-
County distress				(<i>df</i> =2) 0.0840
Tier one	146 (27.1)	109 (24.8)	37 (37.0)	0.48 (0.16, 1.45)
Tier two	228 (42.3)	191 (43.5)	37 (37.0)	1.17 (0.49, 2.79)
Tier three ^{RC}	165 (30.6)	139 (31.7)	26 (26.0)	-
Median HH income (per \$1000) ^c	55.8 ± 11.5	56.1 ± 11.7	54.5 ± 10.7	1.01 (0.97, 1.06)
% Minority	41.7 ± 17.9	41.3 ± 17.8	43.2 ± 18.4	1.00 (0.98, 1.02)

Note. **p*<0.05, ***p*<0.01, ****p*<0.001. RC = Reference category.

^a Perceived mental health status assessed with a 5-point scale ranging from excellent to poor with a higher score indicating poorer mental health

^b Perceived peer nonmedical use of prescription medications assessed with a 5-point scale ranging from none to all peers with a higher score indicating a greater percentage of friends engaging in nonmedical prescription medicine use.

^c Median household income (U.S. Census Bureau, 2020)

More research is needed to elucidate ways in which these YYAs learn about harm reduction strategies to inform the dissemination of these interventions.

In the adult population, drug overdose death rates have increased for all racial and ethnic groups except non-Hispanic Asian populations (Spencer et al., 2022) and this increase has occurred exponentially for people who identify as non-Hispanic Black and non-Hispanic American Indian or Alaska Native (Kariisa, 2022). Among YYA populations, people who identify as male and non-Hispanic White have been documented to be at heightened risk of experiencing an overdose death (Tanz, 2022). We found minimal differences based on biological sex and racial-ethnic group affiliation. However, YYAs who identified as Black were significantly less likely than those who identified as White to perceive they had access to fentanyl test strips. There are documented racial and ethnic disparities in accessing and utilizing harm reduction services for overdose prevention among adults (Khan et al., 2023; Rodriguez et al., 2024). A rapid ethnographic assessment found that a history of racialized policing, legacies of racism, and differential implications of harm reduction policies for populations who experience racialized criminalization shape experiences with overdose prevention and harm reduction (Lopez et al., 2022). Delivery of harm reduction services to YYA should consider the legacies of racialized criminalization and exclusion to reduce disparities in access to services.

YYAs residing in counties ranked as Tier 1 (most distressed), compared to Tier 3 (least distressed), were less likely to perceive access to naloxone. The NC Department of Commerce calculates the county distress rankings based on average unemployment rate, median

household income, percentage growth in population, and adjusted property tax base per capita (North Carolina Department of Commerce, 2021). We examined one metric of the county distress rankings separately, county-level median household income, and found that participants residing in counties with lower median household incomes were less likely than those residing in counties with higher median household incomes to perceive that they had access to naloxone. This finding is consistent with the findings about county distress rankings. Naloxone may be less available to YYAs in under-resourced communities. A 2019 study of pharmacies in NC found that pharmacies located in communities with a higher percentage of residents on public insurance had lower odds of naloxone availability (Egan et al., 2020). Additionally, these communities may be less likely to have post secondary academic institutions or organizations that serve YYAs and can connect them with harm reduction resources. Community-engaged research is needed to better understand ways to improve YYA access to naloxone in communities identified as high distress.

4.1. Limitations

There were limitations to note. It is likely that YYAs underreported substance use, especially as interviews were conducted over the phone rather than self-administered. While the goal was to obtain a geographically diverse sample of YYAs, the absence of specific quotas for participants based on race/ethnicity, socioeconomic status (SES), and gender and sexual identity resulted in a final sample that was not representative of YYAs in NC along those dimensions. This limitation

Table 2
Awareness of and access to naloxone among youth and young adults in North Carolina.

	Overall	Knows about naloxone	Does not know about naloxone	Knowledge (Yes vs No)	Has access to naloxone	No access to naloxone	Access to naloxone (Yes vs No)
	<i>n</i> (%) or <i>M</i> ± <i>SD</i>	<i>n</i> (%) or <i>M</i> ± <i>SD</i>	<i>n</i> (%) or <i>M</i> ± <i>SD</i>	AOR (95 % CI)	<i>n</i> (%) or <i>M</i> ± <i>SD</i>	<i>n</i> (%) or <i>M</i> ± <i>SD</i>	AOR (95 % CI)
Overall	539 (100)	431 (80.0)	108 (20.0)	-	232 (43.0)	307 (57.0)	-
Sociodemographic characteristics							
Age in years	21.9 ± 2.7 (range: 12–25)	22.2 ± 2.5 (range: 14–25)	21.0 ± 3.3 (range: 12–25)	1.36*** (1.14, 1.62)	22.2 ± 2.4 (range: 16–25)	21.7 ± 2.9 (range: 12–25)	1.26*** (1.10, 1.45)
Biological sex							
Female	177 (32.8)	139 (32.3)	38 (35.2)	1.13 (0.70, 1.84)	73 (31.5)	104 (33.9)	1.08 (0.72, 1.62)
Male ^{RC}	361 (67.0)	291 (67.5)	70 (64.8)	-	158 (68.1)	203 (66.1)	-
missing	1 (0.2)						
Race/Ethnicity				(<i>df</i> =2).2651			(<i>df</i> =2).7764
Black	106 (19.7)	90 (20.9)	16 (14.8)	1.28 (0.67, 2.46)	42 (18.1)	64 (20.9)	0.85 (0.53, 1.36)
Other Race	52 (9.7)	34 (7.9)	18 (16.7)	0.66 (0.35, 1.25)	19 (8.2)	33 (10.8)	1.02 (0.52, 1.99)
White ^{RC}	381 (70.7)	307 (71.2)	74 (68.5)	-	171 (73.7)	210 (68.4)	-
Mental health (range = 0–4) ^a	2.1 ± 1.3	2.0 ± 1.3	2.7 ± 1.3	0.69*** (0.56, 0.84)	1.9 ± 1.3	2.3 ± 1.3	0.85* (0.73, 0.98)
Enrolled in				(<i>df</i> =3) <.0001			(<i>df</i> =3) <.0001
Elementary/Middle	5 (0.9)	0	5 (4.6)	<i>n</i> / <i>e</i> [†]	0	5 (1.6)	<i>n</i> / <i>e</i> [†]
High School	61 (11.3)	47 (10.9)	14 (13.0)	5.62* (1.35, 23.3)	21 (9.1)	40 (13.0)	4.11* (1.33, 12.7)
2 yr. College	10 (1.9)	6 (1.4)	4 (3.7)	0.66 (0.12, 3.74)	5 (2.2)	5 (1.6)	2.45 (0.52, 11.6)
4 yr. College/Graduate	223 (41.4)	186 (43.2)	37 (34.3)	2.33 (1.16, 4.70)	114 (49.1)	109 (35.5)	2.81*** (1.68, 4.69)
Not in school/college ^{RC}	240 (44.5)	192 (44.6)	48 (44.4)	-	92 (39.7)	148 (48.2)	-
Peer use Rx meds (range = 0–4) ^b	1.2 ± 0.8	1.3 ± 0.8	1.0 ± 0.8	1.34 (0.98, 1.82)	1.4 ± 0.7	1.0 ± 0.8	1.78*** (1.37, 2.30)
Community characteristics							
Urbanicity				(<i>df</i> =2).4280			(<i>df</i> =2).2041
Rural	202 (37.5)	158 (36.7)	44 (40.7)	0.86 (0.36, 2.10)	77 (33.2)	125 (40.7)	0.58 (0.26, 1.25)
Suburban	210 (39.0)	175 (40.6)	35 (32.4)	1.30 (0.68, 2.49)	95 (41.0)	115 (37.5)	0.94 (0.53, 1.65)
Urban ^{RC}	127 (23.6)	98 (22.7)	29 (26.9)	-	60 (25.9)	67 (21.8)	-
Population density (population/sq.mi)	519.9 ± 557.7	517.4 ± 556.9	529.9 ± 563.5	-	562.7 ± 591.0	487.6 ± 529.9	-
County distress				(<i>df</i> =2).6498			(<i>df</i> =2).0344
Tier one	146 (27.1)	115 (26.7)	31 (28.7)	1.64 (0.57, 4.75)	53 (22.8)	93 (30.3)	0.33* (0.14, 0.77)
Tier two	228 (42.3)	187 (43.4)	41 (38.0)	1.35 (0.60, 3.05)	104 (44.8)	104 (40.4)	0.63 (0.34, 1.18)
Tier three ^{RC}	165 (30.6)	129 (29.9)	36 (33.3)	-	75 (32.3)	75 (29.3)	-
Median HH income (in \$1000 s) ^c	55.8 ± 11.5	55.9 ± 11.4	55.7 ± 12.0	1.02 (0.98, 1.06)	56.0 ± 11.2	55.7 ± 11.7	0.97* (0.93, 1.00)
% Minority 12–18	41.7 ± 17.9	41.3 ± 17.4	43.1 ± 19.8	1.00 (0.98, 1.01)	42.8 ± 18.2	40.8 ± 17.6	1.01 (0.99, 1.02)

Note. **p*<0.05, ***p*<0.01, ****p*<0.001. RC = Reference category. † *n*/*e* = Not estimable as 0 cases within category.

^a Perceived mental health status assessed with a 5-point scale ranging from excellent to poor with a higher score indicating poorer mental health

^b Perceived peer nonmedical use of prescription medications assessed with a 5-point scale ranging from none to all peers with a higher score indicating a greater percentage of friends engaging in nonmedical prescription medicine use.

^c Median household income (U.S. Census Bureau, 2020)

was addressed by applying weights in the analyses. Similar to other online survey platforms, Qualtrics® tends to attract a disproportionate number of well-educated survey participants (Heen et al., 2014). The sample likely excludes YYAs who have unstable housing or lack access to a telephone and may be at an increased risk of experiencing or witnessing an opioid overdose (Burke et al., 2022). Questions regarding naloxone access and fentanyl test strips were only posed to participants who have ever used diverted prescription medications, hallucinogens, cocaine, methamphetamine, heroin, or fentanyl which excludes potential bystanders who do not use these substances but could administer naloxone if they witness an overdose. It also minimizes our ability to stratify and compare across groups based on their substance use history (e.g., no use, opioid use, non-opioid use). Although results can be generalized to YYAs who have experience with substance use in NC, they may not apply to YYAs across the US and other countries.

5. Conclusions

YYAs are experiencing increased rates of opioid-involved drug overdose exceeding the overall percentage increase in total overdose deaths in the US (Tanz, 2022). Efforts are needed to better disseminate naloxone and fentanyl test strips to YYAs who have experience with substance use. Strategies may include educating YYAs and parents about harm reduction strategies in academic and medical settings, providing access to naloxone and fentanyl test strips in academic and community settings, and social media campaigns to deliver accurate and age-appropriate content. A common misperception about educating youth about harm reduction interventions is that it will increase the likelihood that they will engage in substance use behavior (Tas et al., 2019). However, research does not support the hypothesis that expanding the availability of harm reduction interventions increases youth and young adult substance use; rather, naloxone expansion has been associated with reductions in youth heroin and injection drug use (Bruzelius et al., 2023). Information and resources should be

Table 3
Awareness of and perceived access to fentanyl test strips among NC youth and young adults (n=539).

	Overall	Knows about test strips	Does not know about test strips	Knowledge about test strips (Yes vs No)	Has access to test strips	No access to test strips	Access to test strips (Yes vs No)
	n (%) or M ± SD	n (%) or M ± SD	n (%) or M ± SD	AOR (95 % CI)	n (%) or M ± SD	n (%) or M ± SD	AOR (95 % CI)
Overall	539 (100)	401 (74.4)	138 (25.6)	-	118 (21.9)	421 (78.1)	-
Sociodemographic Characteristics							
Age in years	21.9 ± 2.7 (range: 12–25)	22.2 ± 2.5 (range: 14–25)	21.3 ± 3.2 (range: 12–25)	1.28** (1.10, 1.49)	22.7 ± 2.2 (range: 17–25)	21.7 ± 2.8 (range: 12–25)	1.26** (1.07, 1.49)
Biological sex							
Female	177 (32.8)	131 (32.7)	46 (33.3)	1.24 (0.79, 1.95)	33 (28.0)	144 (34.2)	1.02 (0.62, 1.67)
Male ^{RC}	361 (67.0)	269 (67.1)	92 (66.7)	-	84 (72.0)	277 (65.8)	-
Race/Ethnicity				(df=2).9332			(df=2).0104
Black	106 (19.7)	82 (20.5)	24 (17.4)	1.09 (0.63, 1.88)	16 (13.6)	90 (21.4)	0.52* (0.28, 0.95)
Other Race	52 (9.7)	34 (8.5)	18 (13.0)	0.95 (0.49, 1.87)	13 (11.0)	39 (9.3)	2.01 (0.92, 4.37)
White ^{RC}	381 (70.7)	285 (71.1)	96 (69.6)	-	89 (75.4)	292 (69.4)	-
Mental health (range = 0–4) ^a	2.1 ± 1.3	2.0 ± 1.3	2.5 ± 1.3	0.76** (0.64, 0.90)	1.5 ± 1.2	2.3 ± 1.3	0.67*** (0.57, 0.79)
Enrolled in				(df=3) <.0001			(df=3) <.0001
Elementary/Middle	5 (0.9)	0	5 (3.6)	n/e [†]	0	5 (1.2)	n/e [†]
High School	61 (11.3)	45 (11.2)	16 (11.6)	4.99* (1.44, 17.3)	7 (12.4)	54 (12.8)	2.15 (0.48, 9.64)
2 yr. College	10 (1.9)	6 (1.5)	4 (2.9)	0.73 (0.15, 3.67)	5 (1.1)	5 (1.2)	4.40 (0.83, 23.4)
4 yr. College/Graduate	223 (41.4)	172 (42.9)	51 (37.0)	1.96* (1.07, 3.57)	49 (41.4)	174 (41.3)	1.48 (0.83, 2.64)
Not in school/college ^{RC}	240 (44.5)	178 (44.4)	62 (44.9)	-	57 (49.3)	183 (43.5)	-
Peer use Rx meds (range = 0–4) ^b	1.2 ± 0.8	1.3 ± 0.8	1.0 ± 0.8	1.29 (0.98, 1.71)	1.5 ± 0.8	1.1 ± 0.8	1.53** (1.14, 2.06)
Community characteristics							
Urbanicity				(df=2).3636			(df=2).5620
Rural	202 (37.5)	155 (38.7)	47 (34.1)	1.05 (0.43, 2.58)	54 (45.8)	148 (35.2)	1.63 (0.66, 4.06)
Suburban	210 (39.0)	151 (37.7)	59 (42.8)	0.74 (0.40, 1.38)	40 (33.9)	170 (40.4)	1.29 (0.62, 2.68)
Urban ^{RC}	127 (23.6)	95 (23.7)	32 (23.2)	-	24 (20.3)	103 (24.5)	-
Population density (population/sq.mi)	519.9 ± 557.7	518.5 ± 560.5	524.1 ± 551.7	-	491.4 ± 595.0	527.9 ± 547.3	-
County distress				(df=2).3559			(df=2).1825
Tier one	146 (27.1)	108 (26.9)	38 (27.5)	0.84 (0.34, 2.06)	36 (30.5)	110 (26.1)	0.44 (0.17, 1.17)
Tier two	228 (42.3)	177 (44.1)	51 (37.0)	1.35 (0.65, 2.78)	44 (37.3)	184 (43.7)	0.52 (0.25, 1.09)
Tier three ^{RC}	165 (30.6)	116 (28.9)	49 (35.5)	-	38 (32.2)	127 (30.2)	-
Median HH income (per \$1000) ^c	55.8 ± 11.5	55.4 ± 11.3	57.0 ± 12.1	0.99 (0.96, 1.03)	54.4 ± 11.6	56.2 ± 11.4	0.97 (0.94, 1.01)
% Minority 12–18	41.7 ± 17.9	41.8 ± 17.8	41.3 ± 18.1	1.00 (0.99, 1.02)	43.3 ± 19.5	41.2 ± 17.4	1.01 (0.99, 1.02)

Note. *p<0.05, **p<0.01, ***p<0.001. RC = Reference category. † n/e = Not estimable as 0 cases within category.

^a Perceived mental health status assessed with a 5-point scale ranging from excellent to poor with a higher score indicating poorer mental health

^b Perceived peer nonmedical use of prescription medications assessed with a 5-point scale ranging from none to all peers with a higher score indicating a greater percentage of friends engaging in nonmedical prescription medicine use.

^c Median household income (U.S. Census Bureau, 2020)

disseminated to YYAs in an age-appropriate knowledge translation approach that leverages the context in which YYAs live and centers YYA perspectives (Ackermann et al., 2022; Jenkins et al., 2017; Kimmel et al., 2021).

Role of Funding Source

Research reported in this publication was supported by Substance Abuse and Mental Health Services Administration through the NC Department of Health and Human Services, Division of Mental Health, Development and Disabilities, Substance Use Services (NCDHHS-DMH/DD/SUS) under Substance Use Block Grant Award Numbers: TI085825; TI084663; TI083468; TI083540; TI083050. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NCDHHS-DMH/DD/SUS.

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Declaration of Competing Interest

No conflict declared.

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