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Predisposing, Enabling, and Reinforcing Factors Associated with Opioid Addiction Helping Behavior in Tri-State Appalachian Counties: An Application of PRECEDE–PROCEED Model

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Abstract

Objectives The opioid epidemic was designated a "Public Health Emergency" in the United States (US) on October 26th, 2017, bringing renewed attention to this insidious and pervasive problem. Appalachia remains plagued by the effects from years of over-prescription of opioids, and subsequently opioid abuse and addiction. This study aims to examine the utility of PRECEDE-PROCEED Model constructs (i.e., knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors) in predicting opioid addiction helping behavior (i.e., help someone who has an opioid addiction) among individuals living in Tri-state Appalachian Counties.

Design Cross-sectional study

Setting Rural Appalachian Kentucky County

Participants A total of 213 participants from a retail mall in a rural Appalachian Kentucky county completed the survey. Most participants were between the ages of 18 and 30 ($n = 68$; 31.9%) and identified as male ($n = 139$; 65.3%).

Primary outcome measure Opioid addiction helping behavior

Results The regression model was significant, $F_{(6, 180)} = 26.191$, $p < 0.001$ and explained 44.8% of the variance in opioid addiction helping behavior ($R^2 = .448$). Attitude towards helping someone with opioid addiction ($B = .335$; $p < .001$), behavioral skills ($B = .208$; $p = .003$), reinforcing factors ($B = .190$; $p = .015$), and enabling factors ($B = .195$; $p = .009$) were all significant predictors of opioid addiction helping behavior.

Conclusions PRECEDE-PROCEED Model constructs have utility for predicting opioid addiction helping behavior among individuals in a region greatly impacted by the opioid epidemic. Future interventions using PRECEDE-PROCEED Model constructs should be developed to address the opioid epidemic in this region.

Strengths and limitations of this study

- This study assessed predictive utility of PRECEDE-PROCEED model constructs in explaining opioid addiction helping behavior.
- Data were collected from the rural Appalachian region of the US, where the opioid epidemic has had some of its worst effects.
- The knowledge gained from this study may be used to design future educational intervention programs to encourage opioid addiction helping behavior.
- Since the study was cross-sectional, no inferences about causality or directionality between the variables could be drawn.
- Results are based on self-reported data, which may be impacted by social desirability and recall bias.

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Introduction

On October 26th, 2017, the opioid epidemic was declared a "Public Health Emergency" in the United States (US), which brought renewed focus to this insidious and pervasive problem. Since 1999, nearly 841,000 people have died in the US due to a drug overdose, where 72.9% of those deaths involved an opioid [1]. In 2019 alone, opioids were involved in 49,860 overdose deaths in the US [1]. In 2019, it is estimated that about 10.1 million people in the US aged 12 or older had misused opioids in the last year, with 9.7 million of those misusing prescription pain relievers and 745,000 people using heroin [2]. An estimated 21-29% of patients prescribed opioids for chronic pain end up misusing the prescription medications, and another 8-12% develop an opioid use disorder [3]. Furthermore, the CDC estimates a $78.5 billion/year total economic burden of prescription opioid misuse in the United States [4].

Major efforts have been made to curb this crisis; however, age-adjusted overdose death rates increased by 4% from 2018 to 2019 (20.7 to 21.6 per 100,000, respectively), illustrating that there is still much work to be done to curb the opioid epidemic [1]. National public health initiatives, including the HHS's 2017 *5-Point Strategy to Combat the Opioid Epidemic* and the CDC's *Overdose Data to Action* 3-year cooperative agreement, initiated in September 2019, are ongoing and outline the importance of gathering more specific public health data, providing innovative prevention approaches, and expanding research on addiction [5, 6].

The Appalachian region of the US, including Kentucky, Tennessee, and Virginia, experiences some of the most detrimental impacts from the opioid epidemic. Tennessee prescribes the third most opioids in the country at 68.5 prescriptions per 100 people, with Kentucky in fifth at 68.2 and Virginia with 37.6 in 2020 [7]. Although the number of opioid prescriptions has decreased in recent years, overdose deaths increased 60% in Tennessee from

2013 to 2017, which can mostly be attributed to a nearly ten-fold increase in fentanyl related deaths during this time [8]. Kentucky, Tennessee, and Virginia rank 13th, 14th, and 16th, respectively, for fentanyl overdose with Virginia at 11th and Tennessee at 13th for heroin overdoses [8]. The cost of lost tax revenue due to opioid misuse cost $48 million in Tennessee, $344 million in Kentucky, and $495 million in Virginia [9]. Further action will continue to be necessary in the Appalachian region as this issue evolves from one class of opioids to another.

At the epicenter of the national opioid epidemic, the tri-state rural Appalachian communities of Kentucky, Tennessee, and Virginia have experienced this public health crisis firsthand. Claiborne County, Tennessee was recently listed as the seventh highest morphine equivalents per capita annually, quadrupling the national average [10]. During 2018, the tri-state region saw a startling rate of opioid prescriptions per 100 residents at 140.9 in Wise County, Virginia, 148.2 in Claiborne County, Tennessee, and 197.9 in Bell County, Kentucky with a national average of 51.4 [11]. As of 2018, the drug overdose rate per 100,000 residents is 38 in Bell County Kentucky, 40 in Wise County Virginia, and 41 in Claiborne County Tennessee compared to the national average of 21.7 [8, 11, 12]. There is a critical need for drastic measures to be taken at both national, state, and county levels.

An educational evaluation, like a medical diagnosis, aids in the direction of an intervention based on identified needs. The PRECEDE-PROCEED model utilizes four assessment phases, one implementation phase, and three evaluation phases, to produce change within a population at risk. Assessment phases first include a review of social, epidemiological, behavioral, environmental, educational, and ecological factors that together provide a clear picture of the target population in relation to the health issue. The program development is then based on data ascertained from the assessment categories and milestones are created in the form

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of measurable objectives [13]. The PRECEDE-PROCEED model has utility to address the opioid epidemic as a health promotion practice framework and to make recommendations for social, epidemiological, behavioral, environmental, educational, and ecological targets for future programming.

The PRECEDE-PROCEED model helps officials to better grasp the issues facing them and their respective span of control. To achieve success in the fight against opioid drug overdoses, it's critical to comprehend the PRECEDE-PROCEED model's educational and ecological evaluation phases. Predisposing, reinforcing, and enabling elements are classed as predisposing, reinforcing, and enabling factors in this phase. Predisposing variables are elements that influence the incentive to modify one's conduct (i.e., knowledge, beliefs, attitudes, values, perceptions, existing skills). Enabling variables are precursors to behavioral and environmental change that enable the realization of a motive or environmental policy that supports the behavior (i.e., availability of resources, accessibility, laws, legislations, new skills). Reinforcing factors (i.e., family, classmates, teachers, employers, health providers, community leaders, or decision makers) follow a behavior and give ongoing incentive for maintaining the behavior [14]. Ecological assessment is particularly important as the opioid crisis is worse in some regions of the country including rural Appalachia. Educational strategies will empower those affected by this issue to regain control of their quality of life.

The PRECEDE-PROCEED model has been widely validated with a wide range of populations in cross-cultural contexts over the previous decades of research (Green & Kreuter, 2005). The PRECEDE-PROCEED model has been used to conceptualize a wide range of preventive health behaviors, including HIV prevention, breast self-examination, diabetic self-care, and physical activity [15]. To our knowledge, however, the PRECEDE-PROCEED model

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constructs' predictive usefulness in behavioral research on opioid addiction prevention has yet to be investigated.

The objective of the current study was to examine the utility of the PRECEDE-PROCEED model constructs (i.e., predisposing, reinforcing, and enabling factors) in measuring and predicting opioid addiction helping behavior among individuals living in Tri-state Appalachian Counties. By determining the level of opioid addiction knowledge, attitudes, beliefs, and helping behaviors among individuals in a region greatly impacted by the opioid epidemic, public health education and promotion professionals will gain valuable insight to inform the development, implementation, and evaluation of programs to address opioid addiction in populations with a high prevalence of opioid-related morbidity and mortality. Furthermore, the information gleaned from the PRECEDE-PROCEED model constructs in this study will provide a deeper understanding of how to design and modify customized opioid addiction educational intervention strategies that align with the specific needs of the population of interest.

Methods

Participants for this cross-sectional study were recruited using an intercept sampling strategy in a community in rural, Appalachian Kentucky. Specifically, participants were recruited from a large shopping mall in a community in rural Kentucky in Spring 2019. Researchers intercepted mall patrons to ask for their willingness to participate in the study and complete a survey regarding opioid addiction knowledge, attitudes, beliefs, and helping behavior. Community members that agreed to participate in the study were asked to complete a paper-and-pencil survey onsite at the shopping mall. Participants were informed by members of the research team that their participation in the study was completely voluntary and that they could discontinue participation in the study at any time. Informed consent was obtained verbally

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following review of the consent information with the participant. Participants were given a water bottle for their participation in this study. Participants were also required to indicate "yes" to an item stating, "I am aware that this survey is completely voluntary. I am aware my responses including any identifying information will be kept confidential and will be destroyed" before continuing with the survey. Survey completion took approximately 10 to 15 minutes. Prior to data collection, the Institutional Review Board of the Primary Investigator's institution approved all study protocols (Protocol # 707).

Patient and Public Involvement

None

Measures

Using the PRECEDE-PROCEED framework and the previous literature, a 40-item survey instrument was developed for the present study to assess sociodemographic information, opioid use/misuse/abuse history, knowledge about opioid addiction, attitude about opioid addiction, attitude about helping people with opioid addiction, behavioral skills to help people with an opioid addiction, reinforcing factors, enabling factors, and opioid helping behaviors. To assess the content validity of the items, a panel of six content, instrumentation, and theory experts were consulted and asked to provide feedback about the instrument. The instrument was assessed for readability and the use of clear and appropriate language and was considered acceptable with a Flesch reading ease score of 56.2 and Flesch-Kincaid Grade Level of seventh grade [14]. Following data collection in the present study, all scales were assessed to determine internal consistency reliability using Cronbach's alpha for scales including three or more response options or Kuder-Richardson 20 for scales including two response options (i.e.,

knowledge). All Cronbach's alpha or Kuder-Richardson 20 values for the scales were ≥ .70, demonstrating acceptable internal consistency reliability [16].

Sociodemographic Factors and Opioid Use Behavior

Seven variables were used to assess demographic information, including gender identity, age, highest level of education attained, employment status, average hours worked per week, and yearly household income. Participants were able to select "prefer not to answer" for all demographic variables. All participants were provided with the following definition of opioids at the beginning of the survey instrument to increase accuracy of self-reported responses, "Opioids are a group of drugs that include the illegal drug heroin as well as the legal prescription pain relievers such as codeine, oxycodone, hydrocodone, morphine, fentanyl and others." Three items were used to determine opioid use, misuse, and abuse both for participants and referent others. Two items assessed person opioid use. One item asked, "Have you ever used an opioid drug?" (1=yes; 2=no; 3=I don't know) and a second item asked, "Do you think you have a problem with opioid misuse/abuse?" (1=yes; 2=no). A third item, "Do you know someone who has a problem with opioid misuse/abuse?" (1=yes; 2=no) was used to assess if participants knew someone else who misused or abused opioids.

Predisposing Factors

Predisposing factors, or necessary antecedents to help someone with an opioid addiction, were operationalized in the present study as knowledge, attitude, and existing behavioral skills. Four separate scales were created to assess predisposing factors in the present study.

Knowledge. Eight items were created to assess knowledge about the opioid problem in the United States (Cronbach's alpha=0.62). Response options for the knowledge items included "True," "False," and "Don't know." Responses were coded dichotomously (1=correct;

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2=incorrect). After coding responses, the eight knowledge item scores were summated to get a total knowledge score, which ranged from 0-8, with a higher score indicating a higher level of knowledge about the opioid problem in the United States.

Attitude. Attitude was assessed using two different scales. One six-item scale was created to assess participants' attitudes about opioid addiction (Cronbach's alpha=0.42). Attitude items in both scales were measured on a 5-point Likert scale (1=never; 5=always). A sample item from the attitude about opioid addiction scale states, "Opioid addiction is a serious problem." Responses to the six items were summated to generate a total scale score, where scores ranged from 6 to 30. A higher score indicated a more positive attitude about opioid addiction. Another three-item scale was created to assess participants' attitude about helping people with an opioid addiction (Cronbach's alpha=0.79). An example item from the attitude about helping people with opioid addiction scale states, "I would be willing to talk to someone suffering from opioid addiction about their problem." Responses to the three items were summated to generate a total score ranging from 3 to 15, with higher scores indicating a more positive attitude towards helping people with an opioid addiction.

Behavioral skills. Participants' existing behavioral skills to help someone with an opioid addiction were assessed using a four-item scale (Cronbach's alpha=0.81). Items were assessed using a 5-point Likert scale (1=not at all sure; 5=completely sure). An item from the behavioral skills scale states, "How sure are you that you can help someone with an opioid overdose?" To generate a total scale score, responses to the items were summated. Possible scores on the behavioral skills scale ranged from 4 to 20, with higher scores indicating greater skills to help people with an opioid addiction.

Reinforcing Factors

Reinforcing factors, or those factors that encourage sustained engagement in a behavior, were assessed using three items to determine reinforcing factors to help someone with an opioid addiction, including peer, health care, and familial support (Cronbach alpha's=0.82). Items in the reinforcing factors scale were measured using a 5-point Likert scale (1=not at all sure; 5=completely sure) and summated to generate a total scale score ranging from 3 to 15. A higher score indicated increased reinforcing factors present to help someone with an opioid addiction. An example item from the scale states, "How sure are you that you would receive support from health care professionals to help someone with an opioid addiction?"

Enabling Factors

Enabling factors, or factors in the environment that encourage or support engagement in a health behavior, were assessed using a four-item scale (Cronbach's alpha=0.91). . Response options for the items in the enabling factors scale were assessed using a 5-point Likert scale (1=not at all sure; 5=completely sure). An example item from the scale states, "How sure are you that you would be able to find a community organization to help someone with an opioid addiction?" Reponses were summated to create a total scale score, with scores ranging from 4 to 20. Higher scores indicated a higher presence of enabling factors to help someone with an opioid addiction.

Helping Behavior

Helping behavior was measured using two items (Cronbach's alpha=0.88). An example item from the helping behavior states "How likely is it that you would help someone who has an opioid addiction?" Items were measured using a 5-point Likert scale (1=not at all likely; 5=completely likely). Responses to items were summated to create a helping behavior score,

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ranging from 2 to 10, where a higher score indicated greater helping behavior for people with an opioid addiction.

Data Analysis

SPSS Version 27 was used to analyze all of the data (IBM Corp. Armonk, NY, USA). Internal consistency reliability of the instrument was determined using Cronbach's alpha. For each study variable, descriptive statistics such as mean, standard deviation, normality statistics (such as skewness, kurtosis), and frequencies were determined. Univariate analyses were calculated using independent sample *t*-tests to determine differences in knowledge, attitude, behavioral skills, reinforcing factors, enabling factors, and helping behaviors between participants with previous opioid use and those who did not as well as participants who knew someone who misused or abused opioids and those who did not. Between group differences could not be calculated for those reporting and opioid misuse or abuse problem and those who did not due to only 15 participants reporting current opioid misuse or abuse.

Pearson correlation analysis was used to determine the relationship between helping behavior and the knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors prior to multivariable analysis. For multivariable analysis, a multiple linear regression model was created to determine the ability of the knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors to predict opioid addiction helping behavior. Core assumptions of multiple linear regression (i.e., multicollinearity, linearity, homoscedasticity, independence of residuals, and normality) were not violated. An a priori *p*-value of 0.05 was used for all analyses.

Results

A total of 213 participants completed the survey (Table 1). Most participants were between the ages of 18 and 30 (*n* = 68; 31.9%), identified as male (n = 139; 65.3%), reported a

high school diploma or equivalent as their highest level of education (n = 73; 34.3%), reported an

annual income less than \$15,000 (n = 53; 24.9%), and were currently employed (n = 119;

55.9%). Regarding prescription opioid use, 65.3% (n = 139) of participants reported ever using

opioids personally for any reason, and 62.4% (n = 133) reported knowing an individual who

misused or abused opioids. However, only 7% (n = 15) of participants in this study believed that

they personally had a problem with misusing or abusing opioids.

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Table 1. Participant Characteristics

Characteristic	*n (%)*
Age	
18 – 30	68 (31.9)
31 – 40	38 (17.8)
41 – 50	31 (14.6)
51 – 60	33 (15.5)
61+	42 (19.7)
Prefer not to say	1 (0.5)
Gender	
Female	73 (34.3)
Male	139 (65.3)
Education level	
Less than high school	29 (13.6)
High school or GED	73 (34.3)
Some college	55 (25.8)
Bachelor's degree	36 (16.9)
Graduate degree	10 (4.7)
Professional degree	8 (3.8)
Prefer not to say	2 (0.9)
Income	
Less than $15,000	53 (24.9)
$15,000 - $30,000	42 (19.7)
$30,001 - $45,000	42 (19.7)
$45,001 - $60,000	22 (10.3)
Greater than $60,000	32 (15.0)
Prefer not to say	15 (7.0)
Employment	
Employed	119 (55.9)
Non-employed	89 (41.8)
Prefer not to say	3 (1.4)
Hours worked	
Opioid history	
Ever used opioids personally for any reason	139 (65.3)
Believe they have a problem with misuse or abuse of opioids	15 (7.0)
Know an individual with an opioid misuse or abuse problem	133 (62.4)

Percentages may not total 100 due to missing data in the form of participant omission.

Differences in knowledge, attitude, behavioral skills, reinforcing factors, enabling factors, and helping behaviors were explored between those with previous personal opioid use for any reason (i.e., prescription or non-prescription) and those who did not report previous personal use (Table 2). Attitude toward opioid addiction was significantly higher among those with no personal opioid use (M = 15.44) when compared to participants with personal opioid use (M = 13.89), $t(183) = 2.66$; $p = .009$. There were no significant differences in helping behavior, knowledge, attitude towards helping someone with opioid addiction, behavioral skills, reinforcing factors, or enabling factors between these two groups, all $p > .05$.

Differences in knowledge, attitude, behavioral skills, reinforcing factors, enabling factors, and helping behaviors were explored between participants who knew someone who misused or abused opioids and those who did not (Table 2). Knowledge about the opioid problem was significantly higher among participants who knew someone who misused or abused opioids (M = 5.59) when compared to those who did not (M = 4.55), $t(210) = 3.79$; $p < .001$. Attitude toward opioid addiction was also significantly higher among participants who knew someone who misused or abused opioids (M = 14.85) when compared to those who did not (M = 13.56), $t(190) = 2.13$; $p = .035$. Finally, behavioral skills were also significantly higher among participants who knew someone who misused or abused opioids (M = 9.52) when compared to those who did not (M = 7.80), $t(205) = 2.93$; $p = .004$. There were no significant differences in helping behavior, knowledge, attitude towards helping someone with opioid addiction, reinforcing factors, or enabling factors between these two groups, $p > .05$.

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Table 2. Test of group differences in constructs by personal history

	n	Mean	SD	Mean difference	t	p
Helping behavior						
Personal opioid use	134	6.19	1.99	0.19	0.64	0.521
No personal use	65	6.38	1.90			
Know someone who misuses or abuses opioids	133	6.30	1.83	0.12	0.43	0.666
Does not know someone who misuses or abuses opioids	73	6.18	2.16			
Knowledge						
Personal opioid use	139	5.22	1.87	0.01	0.03	0.978
No personal use	65	5.23	1.86			
Know someone who misuses or abuses opioids	133	5.59	1.66	1.04	3.79	<0.001
Does not know someone who misuses or abuses opioids	78	4.55	2.07			
Attitude toward opioids						
Personal opioid use	123	13.89	3.71	1.55	2.66	0.009
No personal use	61	15.44	3.72			
Know someone who misuses or abuses opioids	123	14.85	3.32	1.29	2.13	0.035
Does not know someone who misuses or abuses opioids	68	13.56	4.31			
Attitude toward helping someone with opioid addiction						
Personal opioid use	136	10.50	2.19	0.41	1.45	0.150
No personal use	64	10.91	1.67			
Know someone who misuses or abuses opioids	132	10.81	1.80	0.49	1.54	0.126
Does not know someone who misuses or abuses opioids	75	10.32	2.41			
Behavioral skills						
Personal opioid use	135	8.53	3.99	1.15	1.84	0.067
No personal use	64	9.69	4.40			
Know someone who misuses or abuses opioids	130	9.52	3.81	1.72	2.93	0.004
Does not know someone who misuses or abuses opioids	76	7.80	4.47			
Reinforcing factors						
Personal opioid use	134	7.14	3.37	0.32	0.65	0.519
No personal use	65	7.46	3.08			
Know someone who misuses or abuses opioids	131	7.12	3.02	0.40	0.80	0.428
Does not know someone who misuses or abuses opioids	75	7.52	3.68			
Enabling factors						
Personal opioid use	133	8.95	4.75	0.44	0.62	0.537
No personal use	65	9.38	4.50			
Know someone who misuses or abuses opioids	132	9.20	4.48	0.04	0.07	0.946
Does not know someone who misuses or abuses opioids	73	9.15	4.96			

[†]Welch's t-test.

Pearson correlation analyses were calculated to determine the relationship between helping behavior and knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors (Table 3). Helping behavior was found to demonstrate significant, weak to moderate positive correlations with attitude towards opioid addiction ($r = .344$; $p < .001$), attitude towards helping someone with an opioid addiction ($r = .527$; $p < .001$), behavioral skills ($r = .487$; $p < .001$), reinforcing factors ($r = .567$; $p < .001$), and enabling factors ($r = .522$; $p < .001$). There was no significant correlation between helping behavior and knowledge about the opioid problem.

Table 3. Zero-order correlation matrix of study variables

	Construct	1	2	3	4	5	6	7
1.	Helping behavior	-	0.033	0.344**	0.527**	0.487**	0.567**	0.522**
2.	Knowledge		-	0.185*	0.064	0.263**	0.097	0.120
3.	Attitude: opioid addiction			-	0.276**	0.407**	0.350**	0.431**
4.	Attitude: helping someone with opioid addiction				-	0.242**	0.361**	0.273*
5.	Behavioral skills					-	0.548**	0.495**
6.	Reinforcing factors						-	0.631**
7.	Enabling factors							-

*p < 0.05
**p < 0.001

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A multivariable linear regression model was created to determine the ability of knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors to predict helping behavior (Table 4). The regression model was significant, $F_{(6, 180)} = 26.191$, $p < 0.001$ and explained 44.8% of the variance in helping behavior ($R^2 = .448$). Attitude towards helping someone with opioid addiction ($B = .335$; $p < .001$), behavioral skills ($B = .208$; $p = .003$), reinforcing factors ($B = .190$; $p = .015$), and enabling factors ($B = .195$; $p = .009$) were all significant predictors of helping behavior, where increases in all variables were associated with an increase in helping behavior.

Table 4. Multiple regression models of helping behavior onto predictor variables

	b	S.E.	B	p	LBCI	UBCI
Knowledge	-0.064	0.057	0.064	0.262	-0.176	0.048
Attitudes: toward opioids	0.017	0.032	0.034	0.599	-0.046	0.079
Attitude: toward helping someone with opioid addiction	0.330	0.058	0.335	< 0.001	0.215	0.444
Behavioral skills	0.096	0.032	0.208	0.003	0.033	0.159
Reinforcing factors	0.111	0.045	0.190	0.015	0.022	0.200
Enabling factors	0.079	0.030	0.195	0.009	0.020	0.138
Model statistics: Adjusted $R^2 = 0.448$, $F_{(6, 180)} = 26.191$, $p < 0.001$						

S.E. = standard error of the estimate; *LBCI* = lower bound of the *95% confidence interval*; *UBCI* = upper bound of the *95% confidence interval*.

Discussion

The findings from the present study have important implications for understanding helping behavior related to opioid addiction. In our study, participants who had never used opioids had more positive attitudes about opioid use when compared to those who had previously used opioids, for prescription and non-prescription reasons. Additionally, people who knew

someone who misused or abused opioids demonstrated greater knowledge about the opioid problem, attitudes about opioid addiction, and greater behavioral skills to help someone with an opioid addiction. In the multivariable regression model, we were able to explain a large proportion of variance in helping behavior (44.8%), where attitude towards helping someone with an opioid addiction, behavioral skills, reinforcing factors, and enabling factors were all significant predictors of helping behavior. In the multivariable model, predisposing (i.e., attitude, skills), enabling, and reinforcing factors were all significantly and positively associated with higher helping behavior scores, supporting the utility of the PRECEDE-PROCEED framework for this analysis and to address helping behavior in future health promotion interventions and programs.

In our sample, 65.3% of participants reported ever using an opioid, for both prescription and non-prescription reasons, and 62.4% reported knowing someone who misused or abused opioids. Although national rates of opioid dispensing have decreased in recent years, from 81.3 prescriptions per 100 persons in 2012 to 43.3 per 100 persons in 2020, some states still report higher than average rates of prescription opioid dispensing [17]. For example, in Kentucky where the data for the present study were collected, the dispensing rate in 2020 was 68.2 per 100 persons, mirroring the proportion of participants in the present study that reported ever using an opioid for both prescription and non-prescription reasons [7]. Additionally, over half of the sample reported personally knowing someone who misused or abused opioids, highlighting the magnitude of the opioid epidemic in this region of the country. This demonstrates that there is a continued need for educational programming and health promotion strategies to combat the opioid epidemic in the United States, especially in areas such as Appalachia, which have been hit

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the hardest and continue to fall behind other regions of the country in reducing opioid misuse, abuse, and dispensing rates.

There were very few differences between participants in this study that reported previous prescription or non-prescription use of opioid medications and those that did not, but there was a higher attitude towards opioid addiction score among participants who reported no previous use when compared to those who had previously used opioid medication. Items in the attitude toward opioid addiction scale assessed factors such as ability to treat addiction, magnitude of the seriousness of the opioid epidemic, and ability to seek help and manage an addiction. Higher scores on this scale were likely reported among those who had no previous opioid use because those participants may not be familiar with the addictive nature of opioid medications and the associated difficulty in overcoming an addiction. It would be important for practitioners and researchers working to address changing attitudes among those who have previous opioid use in order to increase perceptions of help seeking, management, and seriousness of an opioid misuse and abuse.

Additional differences were found between participants who knew someone who misused or abused opioids when compared to those who did not personally know someone suffering from opioid addiction. Specifically, participants who knew someone who misused or abused opioids had higher knowledge about the opioid problem, more positive attitude about opioid addiction, and greater behavioral skills to help someone with an opioid addiction (i.e., effective communication, helping with an overdose, referring someone to a health professional). These differences were likely due to their personal experiences or skills they have acquired to potentially assist others with negative outcomes associated with opioid misuse and abuse, such as an accidental overdose. Additionally, people who did not currently know someone who misused

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or abused opioids may have been influenced by societal stigma associated with the opioid epidemic, impacting their knowledge and attitude about opioid addiction [18-21]. Previous research has linked higher levels of stigma toward people who use prescription opioids to increased support for punitive policies, less support for public health and prevention measures, and a decreased motivation to interact with people who use opioids [19-21]. Like the findings in our study, a recent study among US young adults also found that people with less personal experience with opioid use disorder were more likely to exhibit more negative attitudes towards opioid use [18].

These findings align with current strategies to curb the opioid epidemic in the US, including the use naloxone-based interventions to equip bystanders to intervene and administer life-saving medical treatment during an overdose [22, 23]. A recent review of naloxone-based interventions showed that these interventions are most effective when framed in a harm reduction context supportive of people who use opioids, in communities where Good Samaritan laws are present, and when societal attitudes towards people who misuse or abuse opioids are positive [22]. Additionally, aside from encouraging reductions in dispensing of opioid medications, current public health strategies rely on interpersonal relationships and familial influence to help combat the opioid epidemic. This finding is promising but also shows a need to educate people that do not currently know someone who misuses or abuses opioids to respond effectively when interacting with individuals with an opioid addiction or in response to an overdose. Future research should continue to explore attitude, knowledge, and skills, to develop strategies to increase these important predisposing factors to opioid helping behavior for the general population.

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In the multivariable regression model, we found that predisposing factors, including attitude and behavioral skills to help someone with an opioid addiction, as well as reinforcing and enabling factors were significantly associated with increased helping behavior in our sample. The combination of these variables also explained a high proportion of the variance in helping behavior (44.8%), which is substantial for psychosocial and health behavior research [24]. This finding is important for two reasons. One, this finding supports the utility of the PRECEDE-PROCEED framework for designing, implementing, and evaluating intervention strategies to address opioid addiction in a population with high prevalence of opioid-related morbidity and mortality. Second, these findings provide insight into specific behavioral antecedents that can be incorporated into tailored educational interventions that directly align with the needs of this this population of interest.

Predisposing factors, specifically attitude and skills to help someone with an opioid addiction, were associated with greater helping behavior in this sample. These factors could be incorporated into educational programming to increase helping behavior to address opioid addiction. In addition to addressing changes in knowledge and attitude through educational strategies, public health education professionals should include public training on how to effectively help someone with a drug overdose, such as using take-home naloxone [23]. These types of trainings have been shown to be an effective strategy to increase skills and helping behavior in other populations, particularly when structured in harm reduction context and when delivered in a peer-to-peer format [22]. Public health professionals should consider implementing naloxone-based trainings, an important predisposing skill to address potential opioid-related overdoses, in communities substantially impacted by the opioid epidemic in order to equip all members of the community to intervene with bystander or peer-to-peer intervention.

Reinforcing factors, operationalized in this study as social support from a variety of sources, was also associated with increased helping behavior in our sample. Reinforcing factors may include improvements in peer, familial, and healthcare provider support to help someone with an opioid addiction. Research has shown that familial as well as healthcare provider support can be a promising strategy to increase the likelihood of helping people with an opioid addiction [25, 26]. Research on familial support has shown that interventions should use strategies to increase attitude and knowledge toward prescription opioid misuse as well as provide resources and develop skills to help facilitation prevention [25]. Findings from a recent comprehensive literature review on the opioid crisis from the perspective of the healthcare system also supported the need for improved education of healthcare providers, including upstream educational programs that prepare healthcare providers to better combat the opioid crisis [26]. Public health professionals should work to increase these interpersonal relationships to better equip peers, family members, and healthcare professionals to provide appropriate support to those impacted by opioid addiction.

Lastly, the presence of enabling factors in the individual's environment, including community organizations, faith-based organizations, healthcare organizations, and other resources, were associated with helping behavior in this sample. This finding emphasizes the need to not only address individual-level factors, such as knowledge and attitude, but also to improve the resources available in the communities where people live. Research on contextual factors that may impact the success of community-based interventions to address opioid use disorders has shown that the health services environment, including the availability and access to substance use services, is an important determinant to successfully addressing the opioid epidemic [27]. In addition to addressing important predisposing and reinforcing factors, public

health professionals working in areas heavily impacted by the opioid epidemic should consider improving the community-level resources available to improve helping behavior among community members.

Limitations

The current study has certain drawbacks. First, utilizing intercept sampling procedures, data were obtained from a sample of mall patrons. Therefore, the participants in the present study may not be representative of the larger population in the surrounding Tri-State Appalachian counties, limiting the generalizability of the study findings. The sample was also predominantly male and young (18-30 years of age), further limiting the generalizability of the findings to women and older age groups. Second, all data were collected using self-report measures. This limitation may increase the likelihood of response bias, including social desirability, which may have impacted the findings in the analysis. Specifically, social desirability may have prevented some participants from feeling comfortable answering the items related to their personal misuse or abuse of opioids. Third, the Cronbach's alpha for the attitudes concerning opioid addiction subscale was low, raising concerns about the subscale's internal consistency reliability. As a result, caution should be used while interpreting the results pertaining to this variable. Last, because the study was cross-sectional, it was impossible to make any conclusions about causation or directionality between the variables. Future studies should employ longitudinal study designs or implement interventions to overcome this limitation.

Conclusions

The findings of this study provide crucial information about the characteristics that predispose, enable, and reinforce helpful behavior among inhabitants in Appalachia, an area that has been severely touched by the US opioid epidemic. Our findings highlight important factors,

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including attitude, skills, reinforcing, and enabling factors, that can directly inform the

development of intervention strategies to address the opioid epidemic in this region. Public

health professionals working to address the opioid epidemic should consider all influences on

helping behavior, including individual-level predisposing factors, interpersonal reinforcing

factors, and community-level enabling factors to develop intervention strategies and programs

that directly reflect the needs of their population of interest. A logical next step in this stream of

research is the development and testing of intervention strategies to address the predisposing,

enabling, and reinforcing factors associated with helping behavior for opioid addiction. Future

research should aim to translate these findings to the development of public health programming.

Since the findings from this study may only be generalizable to people residing in the Tri-County

Appalachian region of the United States where the data were obtained, more research is needed

to explore characteristics related with helping behavior in other groups of interest.

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Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics statements

Patient consent for publication

Not required

Consent obtained directly from patient(s)

All included patients provided oral informed consent, and the study protocol was approved by the Ethics Committee at the Lincoln Memorial University (IRB; Protocol #707 V.3).

Acknowledgments

Authors Contribution

V.K.N. and M.S. contributed to study conceptualization and design; M.S. developed the instrument; P.M.S. and R.W.K. contributed to data collection; V.K.N. and R.E.D. contributed to data analysis; all the authors are responsible for data interpretation; all the authors drafted the article or revised it critically for important intellectual content; all the authors gave final approval of the version of the article to be published; all the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest: None

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	**2**

| Abstract | #1b | Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |

Introduction

| Background / rationale | #2 | Explain the scientific background and rationale for the investigation being reported | 3-6 |
| Objectives | #3 | State specific objectives, including any prespecified hypotheses | 6 |

Methods

Study design	#4	Present key elements of study design early in the paper	6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6-7
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	7-11
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	7-11

Bias	#9	Describe any efforts to address potential sources of bias	11
Study size	#10	Explain how the study size was arrived at	12
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	11
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	11
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	11
Statistical methods	#12c	Explain how missing data were addressed	11
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	6
Statistical methods	#12e	Describe any sensitivity analyses	NA

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-	

up, and analysed. Give information separately for for exposed
and unexposed groups if applicable.   12

| Participants | #13b | Give reasons for non-participation at each stage | 7 |

| Participants | #13c | Consider use of a flow diagram | NA |

Descriptive data   #14a   Give characteristics of study participants (eg demographic,
clinical, social) and information on exposures and potential
confounders. Give information separately for exposed and
unexposed groups if applicable.   12

Descriptive data   #14b   Indicate number of participants with missing data for each
variable of interest   12-14

Outcome data   #15   Report numbers of outcome events or summary measures.
Give information separately for exposed and unexposed
groups if applicable.   12-14

Main results   #16a   Give unadjusted estimates and, if applicable, confounder-
adjusted estimates and their precision (eg, 95% confidence
interval). Make clear which confounders were adjusted for
and why they were included   11 & 28

Main results   #16b   Report category boundaries when continuous variables were
categorized   26

Main results   #16c   If relevant, consider translating estimates of relative risk into
absolute risk for a meaningful time period   NA

Other analyses   #17   Report other analyses done—e.g., analyses of subgroups
and interactions, and sensitivity analyses   11

Discussion

| Key results | #18 | Summarise key results with reference to study objectives | 14 |

Limitations #19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. 19-20

Interpretation #20 Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. 19-20

Generalisability #21 Discuss the generalisability (external validity) of the study results 19-20

Other Information

Funding #22 Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based 21

None The STROBE checklist is distributed under the terms of the Creative Commons Attribution License CC-BY. This checklist can be completed online using https://www.goodreports.org/, a tool made by the EQUATOR Network in collaboration with Penelope.ai

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Cross-Sectional Analysis of the Predisposing, Enabling, and Reinforcing Factors Associated with Opioid Addiction Helping Behavior in Tri-State Appalachian Counties: Application of the PRECEDE–PROCEED Model

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Manuscripts

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Manuscript Type: Original Research

Manuscript Title: Cross-Sectional Analysis of the Predisposing, Enabling, and Reinforcing Factors Associated with Opioid Addiction Helping Behavior in Tri-State Appalachian Counties: Application of the PRECEDE–PROCEED Model

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Abstract

Objectives The overdose epidemic was designated a "Public Health Emergency" in the United States (US) on October 26th, 2017, bringing attention to the severity of this public health problem. The Appalachia region remains substantially impacted by the effects from years of over-prescription of opioids, and subsequently opioid non-medical use and addiction. This study aims to examine the utility of the PRECEDE-PROCEED Model constructs (i.e., predisposing, reinforcing, and enabling factors) to explain opioid addiction helping behavior (i.e., help someone who has an opioid addiction) among members of the public living in Tri-state Appalachian Counties.

Design Cross-sectional study

Setting Rural county in the Appalachian region of the US

Participants A total of 213 participants from a retail mall in a rural Appalachian Kentucky county completed the survey. Most participants were between the ages of 18 and 30 ($n = 68$; 31.9%) and identified as men ($n = 139$; 65.3%).

Primary outcome measure Opioid addiction helping behavior

Results The regression model was significant, $F_{(6, 180)} = 26.191$, $p < 0.001$ and explained 44.8% of the variance in opioid addiction helping behavior ($R^2 = .448$). Attitude towards helping someone with opioid addiction ($B = .335$; $p < .001$), behavioral skills ($B = .208$; $p = .003$), reinforcing factors ($B = .190$; $p = .015$), and enabling factors ($B = .195$; $p = .009$) were all significantly associated with opioid addiction helping behavior.

Conclusions PRECEDE-PROCEED Model constructs have utility to explain opioid addiction helping behavior among individuals in a region greatly impacted by the overdose epidemic. This study provides an empirically tested framework for future programs addressing helping behavior related to opioid non-medical use.

Strengths and limitations of this study

- This study assessed the utility of PRECEDE-PROCEED model constructs in explaining opioid addiction helping behavior.
- Data were collected from the rural Appalachian region of the US, where the overdose epidemic has had some of its worst effects.
- The knowledge gained from this study may be used to design future educational intervention programs to encourage opioid addiction helping behavior.
- Since the study was cross-sectional, no inferences about causality or directionality between the variables could be drawn.
- Results are based on self-reported data, which may be impacted by social desirability and recall bias.

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Introduction

On October 26th, 2017, the overdose epidemic was declared a "Public Health

Emergency" in the United States (US), which brought renewed focus to this dangerous and

pervasive problem. Since 1999, nearly 841,000 people have died in the US due to a drug

overdose, where 72.9% of those deaths involved an opioid [1]. In 2019 alone, opioids were

involved in 49,860 overdose deaths in the US [1]. In 2019, it is estimated that about 10.1 million

people in the US aged 12 or older had non-medically used opioids in the last year, with 9.7

million of those non-medically using prescription pain relievers and 745,000 people using heroin

[2]. An estimated 21-29% of patients prescribed opioids for chronic pain end up non-medically

using the prescription medications, and another 8-12% develop an opioid use disorder [3].

Furthermore, the CDC estimates a $78.5 billion/year total economic burden of prescription

opioid non-medical use in the United States [4].

Major efforts have been made to curb this crisis; however, age-adjusted overdose death

rates increased by 4% from 2018 to 2019 (20.7 to 21.6 per 100,000, respectively), illustrating

that there is still much work to be done to curb the overdose epidemic [1]. National public health

initiatives, including the HHS's 2017 *5-Point Strategy to Combat the Opioid Epidemic* and the

CDC's *Overdose Data to Action* 3-year cooperative agreement, initiated in September 2019, are

ongoing and outline the importance of gathering more specific public health data, providing

innovative prevention approaches, and expanding research on addiction [5, 6].

The Appalachian region of the US, including Kentucky, Tennessee, and Virginia,

experiences some of the most detrimental impacts from the overdose epidemic. Tennessee

prescribes the third most opioids in the country at 68.5 prescriptions per 100 people, with

Kentucky in fifth at 68.2 and Virginia with 37.6 in 2020 [7]. Although the number of opioid

prescriptions has decreased in recent years, overdose deaths increased 60% in Tennessee from 2013 to 2017, which can mostly be attributed to a nearly ten-fold increase in illicit fentanyl related deaths during this time [8]. Kentucky, Tennessee, and Virginia rank 13th, 14th, and 16th, respectively, for illicit fentanyl overdose with Virginia at 11th and Tennessee at 13th for heroin overdoses [8]. The cost of lost tax revenue due to opioid non-medical use cost $48 million in Tennessee, $344 million in Kentucky, and $495 million in Virginia [9]. Further action will continue to be necessary in the Appalachian region as the fentanyl problem continues to evolve.

At the epicenter of the national overdose epidemic, the tri-state rural Appalachian communities of Kentucky, Tennessee, and Virginia have experienced this public health crisis firsthand. Claiborne County, Tennessee was recently listed as the seventh highest morphine equivalents per capita annually, quadrupling the national average [10]. During 2018, the tri-state region saw a startling rate of opioid prescriptions per 100 residents at 140.9 in Wise County, Virginia, 148.2 in Claiborne County, Tennessee, and 197.9 in Bell County, Kentucky with a national average of 51.4 [11]. As of 2018, the drug overdose rate per 100,000 residents is 38 in Bell County Kentucky, 40 in Wise County Virginia, and 41 in Claiborne County Tennessee compared to the national average of 21.7 [8, 11, 12]. Dramatically elevated rates of prescribed opioids and drug overdoses when compared to national trends highlight this area of the country and its residents as a focal population of concern when considering opioid-related harms, inclusive of overdose.

As early research identified associations between opioid prescribing and non-medical use as well as opioid-related harms [13], initial efforts to address opioid-related harms focused largely on controlling supply, primarily by reducing prescribing rates through strategies, such as more rigorous prescribing guidelines, prescription monitoring programs, and drug tapering were

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advocated and applied [14, 15, 16]. Unfortunately, these and other preventative activities lead to evolution of opioid-related problems such as the increased propensity to utilize alternative drugs, inclusive of illicitly manufactured fentanyl. Though prescribing rates have reduced of late resulting from the aforementioned prevention strategies, overdose deaths have continued to rise [8], and localized prescribing rates continue to serve as an indicator of opioid-related harms [17]. Recent US data suggests a 28.5% increase in opioid-related overdose deaths from 2020 – 2021 [18, 19]. Data from the Canadian government indicates similar increases and further suggest there to be no evidence that increases in overdose are related to prescribed opioids [20]. Over the past decade, overdose deaths due to prescription opioids have remained relatively stable, at the same time we have observed inconceivable increases in synthetic opioid-related overdose [21]. Furthermore, laboratory tests conducted by the Drug Enforcement Agency (DEA) found that 6/10 fentanyl-laced pills confiscated in 2022 contained a lethal dosage [22], an increase from 4/10 in 2021. This radical short-term increase highlights the concern over illicitly manufactured and dispensed fentanyl, as well as other drugs contaminated with this fentanyl. Control of illicit fentanyl should be viewed as the highest priority related to the current overdose epidemic.

Emergent research highlights newer concerns related to reduction of opioid prescribing, specifically in the form of "deprescribing" (i.e., tapering and/or complete removal) once opioid-based chronic pain management therapy has been initiated [16]. A recent cohort study among those who underwent opioid dose tapering between 2008 and 2017, inclusive of nearly 20,000 participants found that opioid tapering was associated with increased risk for withdrawal, drug overdose, and mental health crisis [16]. Those with higher initial dose were at greater risk for these deleterious outcomes. Of critical limitation to this study is the temporality of the study period, as guidelines for appropriate tapering of opioids were not published until 2019 [23].

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Thus, the tapering process may have lacked certain safeguards which would now guide a more appropriate tapering process. As prescription opioid use has been shown to precede non-medical use and illicit opioid use [24, 25, 26], there is a critical need for drastic measures to be taken at both national, state, and county levels to reduce opioid-related harms, extending far beyond prescribing-related interventions.

One strategy to address the overdose epidemic is to encourage helping behavior among individuals in the public through the development of peer-to-peer interventions. Helping behavior may include strategies such as administration of naloxone [27] and social support from families, peers, and healthcare providers [28]. Multiple factors have been identified in previous research to be associated with greater likelihood to exhibit helping behavior relevant to opioid non-medical use. Individuals who had more positive attitude toward and reduced stigma towards helping someone with an opioid addiction and skills to help someone with an opioid addiction were more likely to exhibit greater helping behavior [29, 30]. In addition to attitude and skills, research has shown that support from healthcare providers and family is associated with increased likelihood of helping someone with opioid addiction [31, 32]. Outside of individual and interpersonal factors, environmental factors, such as community, faith-based, and healthcare organizations that support helping behavior have also been shown to important factors to address opioid non-medical use [33]. To date, little research has explored factors associated with helping behavior among people living in the Appalachia region using a theoretical framework.

Therefore, the objective of the current study was to examine the utility of the PRECEDE-PROCEED model [34, 35, 36] constructs (i.e., predisposing, reinforcing, and enabling factors) in measuring and explaining opioid addiction helping behavior among members of the public living in Tri-state Appalachian Counties. By determining the level of opioid addiction knowledge,

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attitudes, beliefs, and helping behaviors among members of the public in a region greatly impacted by the overdose epidemic, public health education and promotion professionals will gain valuable insight to inform the development, implementation, and evaluation of programs to address helping behavior related to opioid addiction in populations with a high prevalence of opioid-related morbidity and mortality. Furthermore, the information gleaned from the PRECEDE-PROCEED model constructs in this study will provide a deeper understanding of how to design and modify customized opioid addiction educational intervention strategies that align with the specific needs of the population of interest.

Methods

Theoretical Framework

Using a planning model like PRECEDE-PROCEED, an intervention can be directed based on identified needs. The PRECEDE-PROCEED model utilizes four assessment phases, one implementation phase, and three evaluation phases, to produce change within a population at risk. Assessment phases first include a review of social, epidemiological, behavioral, environmental, educational, and ecological factors that together provide a clear picture of the target population in relation to the health issue. The program development is then based on data ascertained from the assessment categories and milestones are created in the form of measurable objectives [34]. The PRECEDE-PROCEED model has utility to address the overdose epidemic as a health promotion practice framework and to make recommendations for social, epidemiological, behavioral, environmental, educational, and ecological targets for future programming.

The PRECEDE-PROCEED model helps individuals to better grasp the issues facing them and their respective span of control. To achieve success in the fight against opioid drug

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overdoses, it's critical to comprehend the PRECEDE-PROCEED model's educational and ecological evaluation phases. Predisposing, reinforcing, and enabling elements are classed as predisposing, reinforcing, and enabling factors in this phase. Predisposing variables are elements that influence the incentive to modify one's conduct (i.e., knowledge, beliefs, attitudes, values, perceptions, existing skills). Enabling variables are precursors to behavioral and environmental change that enable the realization of a motive or environmental policy that supports the behavior (i.e., availability of resources, accessibility, laws, legislations, new skills). Reinforcing factors (i.e., family, classmates, teachers, employers, health providers, community leaders, or decision makers) follow a behavior and give ongoing incentive for maintaining the behavior [35]. Ecological assessment is particularly important as the opioid crisis is worse in some regions of the country including rural Appalachia. Educational strategies will aid in the empowerment of those affected by this issue and promote improved quality of life for their communities.

The PRECEDE-PROCEED model has been widely validated with a wide range of populations in cross-cultural contexts over the previous decades of research [34, 35, 36]. The PRECEDE-PROCEED model has been used to conceptualize a wide range of preventive health behaviors, including HIV prevention, breast self-examination, diabetic self-care, and physical activity [35, 37]. To our knowledge, however, the PRECEDE-PROCEED model constructs' have yet to be explored in behavioral research on opioid addiction helping behavior has yet to be investigated.

Participant Recruitment

Participants for this cross-sectional study were recruited using an intercept survey sampling strategy in a community in rural, Appalachian Kentucky. Public intercept surveys aim to recruit people from the public from widely used, public locations, such as malls and parks, and

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have been supported as an effective recruitment strategy in rural populations [38]. In this study, participants were recruited from a large shopping mall in a community in rural Kentucky in Spring 2019. Researchers intercepted mall patrons to ask for their willingness to participate in the study and complete a survey regarding opioid addiction knowledge, attitudes, beliefs, and helping behavior. Community members that agreed to participate in the study were asked to complete a paper-and-pencil survey onsite at the shopping mall. Participants were informed by members of the research team that their participation in the study was completely voluntary and that they could discontinue participation in the study at any time. Informed consent was obtained verbally following review of the consent information with the participant. Participants were given a water bottle for their participation in this study. Participants were also required to indicate "yes" to an item stating, "I am aware that this survey is completely voluntary. I am aware my responses including any identifying information will be kept confidential and will be destroyed" before continuing with the survey. Survey completion took approximately 10 to 15 minutes. Prior to data collection, the Institutional Review Board of the Primary Investigator's institution approved all study protocols (Protocol # 707).

Patient and Public Involvement

None

Measures

Using the PRECEDE-PROCEED framework [34, 35, 36], a 40-item survey instrument was developed for the present study to assess sociodemographic information, opioid use/non-medical use history, knowledge about opioid addiction, attitude about opioid addiction, attitude about helping people with opioid addiction, behavioral skills to help people with an opioid addiction, reinforcing factors, enabling factors, and opioid helping behaviors. To assess the

content validity of the items, a panel of six content, instrumentation, and theory experts were consulted and asked to provide feedback about the instrument. The instrument was assessed for readability and the use of clear and appropriate language and was considered acceptable with a Flesch reading ease score of 56.2 and Flesch-Kincaid Grade Level of seventh grade. Following data collection in the present study, all scales were assessed to determine internal consistency reliability using Cronbach's alpha for scales including three or more response options or Kuder-Richardson 20 for scales including two response options (i.e., knowledge). All Cronbach's alpha or Kuder-Richardson 20 values for the scales were ≥ .70, demonstrating acceptable internal consistency reliability [39].

Sociodemographic Factors and Opioid Use Behavior

Seven variables were used to assess demographic information, including gender identity, age, highest level of education attained, employment status, average hours worked per week, and yearly household income. Participants were able to select "prefer not to answer" for all demographic variables. All participants were provided with the following definition of opioids at the beginning of the survey instrument to increase accuracy of self-reported responses, "Opioids are a group of drugs that include the illegal drug heroin as well as the legal prescription pain relievers such as codeine, oxycodone, hydrocodone, morphine, fentanyl and others." Three items were used to determine opioid use/non-medical use both for participants and referent others. Two items assessed person opioid use. One item asked, "Have you ever used an opioid drug?" (1=yes; 2=no; 3=I don't know) and a second item asked, "Do you think you have a problem with opioid misuse/abuse?" (1=yes; 2=no). A third item, "Do you know someone who has a problem with opioid misuse/abuse?" (1=yes; 2=no) was used to assess if participants knew someone else who non-medically used opioids.

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Predisposing Factors

Predisposing factors, or necessary antecedents to help someone with an opioid addiction, were operationalized in the present study as knowledge, attitude, and existing behavioral skills. Four separate scales were created to assess predisposing factors in the present study.

Knowledge. Eight items were created to assess knowledge about opioid addiction in the United States (Cronbach's alpha=0.62). Response options for the knowledge items included "True," "False," and "Don't know." Responses were coded dichotomously (1=correct; 2=incorrect). After coding responses, the eight knowledge item scores were summated to get a total knowledge score, which ranged from 0-8, with a higher score indicating a higher level of knowledge about the overdose epidemic in the United States.

Attitude. Attitude was assessed using two different scales. One six-item scale was created to assess participants' attitudes about opioid addiction (Cronbach's alpha=0.42). Attitude items in both scales were measured on a 5-point Likert scale (1=never; 5=always). A sample item from the attitude about opioid addiction scale states, "Opioid addiction is a serious problem." Responses to the six items were summated to generate a total scale score, where scores ranged from 6 to 30. A higher score indicated a more positive attitude about opioid addiction. Another three-item scale was created to assess participants' attitude about helping people with an opioid addiction (Cronbach's alpha=0.79). An example item from the attitude about helping people with opioid addiction scale states, "I would be willing to talk to someone suffering from opioid addiction about their problem." Responses to the three items were summated to generate a total score ranging from 3 to 15, with higher scores indicating a more positive attitude towards helping people with an opioid addiction.

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Behavioral skills. Participants' existing behavioral skills to help someone with an opioid addiction were assessed using a four-item scale (Cronbach's alpha=0.81). Items were assessed using a 5-point Likert scale (1=not at all sure; 5=completely sure). An item from the behavioral skills scale states, "How sure are you that you can help someone with an opioid overdose?" To generate a total scale score, responses to the items were summated. Possible scores on the behavioral skills scale ranged from 4 to 20, with higher scores indicating greater skills to help people with an opioid addiction.

Reinforcing Factors

Reinforcing factors, or those factors that encourage sustained engagement in a behavior, were assessed using three items to determine reinforcing factors to help someone with an opioid addiction, including peer, health care, and familial support (Cronbach alpha's=0.82). Items in the reinforcing factors scale were measured using a 5-point Likert scale (1=not at all sure; 5=completely sure) and summated to generate a total scale score ranging from 3 to 15. A higher score indicated increased reinforcing factors present to help someone with an opioid addiction. An example item from the scale states, "How sure are you that you would receive support from health care professionals to help someone with an opioid addiction?"

Enabling Factors

Enabling factors, or factors in the environment that encourage or support engagement in a health behavior, were assessed using a four-item scale (Cronbach's alpha=0.91). . Response options for the items in the enabling factors scale were assessed using a 5-point Likert scale (1=not at all sure; 5=completely sure). An example item from the scale states, "How sure are you that you would be able to find a community organization to help someone with an opioid addiction?" Reponses were summated to create a total scale score, with scores ranging from 4 to

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20. Higher scores indicated a higher presence of enabling factors to help someone with an opioid

addiction.

Helping Behavior

Helping behavior was measured using two items (Cronbach's alpha=0.88). An example

item from the helping behavior states "How likely is it that you would help someone with an

opioid addiction seek help from a health professional?" Items were measured using a 5-point

Likert scale (1=not at all likely; 5=completely likely). Responses to items were summated to

create a helping behavior score, ranging from 2 to 10, where a higher score indicated greater

helping behavior for people with an opioid addiction.

Data Analysis

SPSS Version 27 was used to analyze all the data (IBM Corp. Armonk, NY, USA).

Internal consistency reliability of the instrument was determined using Cronbach's alpha. For

each study variable, descriptive statistics such as mean, standard deviation, normality statistics

(such as skewness, kurtosis), and frequencies were determined. Univariate analyses were

calculated using independent sample *t*-tests to determine differences in knowledge, attitude,

behavioral skills, reinforcing factors, enabling factors, and helping behaviors between

participants with previous opioid use and those who did not as well as participants who knew

someone who non-medically used opioids and those who did not. Between group differences

could not be calculated for those reporting an opioid non-medical use problem and those who did

not due to only 15 participants reporting current opioid non-medical use at the time of data

collection.

Pearson correlation analysis was used to determine the relationship between helping

behavior and the knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors

prior to multivariable analysis. For multivariable analysis, a multiple linear regression model was created to determine the ability of the knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors to explain opioid addiction helping behavior. Core assumptions of multiple linear regression (i.e., multicollinearity, linearity, homoscedasticity, independence of residuals, and normality) were not violated. An a priori p-value of 0.05 was used for all analyses.

Results

A total of 213 participants completed the survey (Table 1). Most participants were between the ages of 18 and 30 ($n = 68$; 31.9%), identified as men ($n = 139$; 65.3%), reported a high school diploma or equivalent as their highest level of education ($n = 73$; 34.3%), reported an annual income less than $15,000 ($n = 53$; 24.9%), and were currently employed ($n = 119$; 55.9%). Regarding prescription opioid use, 65.3% ($n = 139$) of participants reported ever using opioids personally for any reason, and 62.4% ($n = 133$) reported knowing an individual who non-medically used opioids. However, only 7% ($n = 15$) of participants in this study believed that they personally had a problem with non-medically using opioids.

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Table 1. Participant Characteristics

Characteristic	n (%)
Age	
18 – 30	68 (31.9)
31 – 40	38 (17.8)
41 – 50	31 (14.6)
51 – 60	33 (15.5)
61+	42 (19.7)
Prefer not to say	1 (0.5)
Gender	
Woman	73 (34.3)
Man	139 (65.3)
Education level	
Less than high school	29 (13.6)
High school or GED	73 (34.3)
Some college	55 (25.8)
Bachelor's degree	36 (16.9)
Graduate degree	10 (4.7)
Professional degree	8 (3.8)
Prefer not to say	2 (0.9)
Income	
Less than $15,000	53 (24.9)
$15,000 - $30,000	42 (19.7)
$30,001 - $45,000	42 (19.7)
$45,001 - $60,000	22 (10.3)
Greater than $60,000	32 (15.0)
Prefer not to say	15 (7.0)
Employment	
Employed	119 (55.9)
Non-employed	89 (41.8)
Prefer not to say	3 (1.4)
Hours worked	
Opioid history	
Ever used opioids personally for any reason	139 (65.3)
Believe they have a problem with non-medical use or abuse of opioids	15 (7.0)
Know an individual with an opioid non-medical use or abuse problem	133 (62.4)

Percentages may not total 100 due to missing data in the form of participant omission.

Differences in knowledge, attitude, behavioral skills, reinforcing factors, enabling factors, and helping behaviors were explored between those with previous personal opioid use for any reason (i.e., prescription or non-prescription) and those who did not report previous personal use (Table 2). Attitude toward opioid addiction was significantly higher among those with no personal opioid use (M = 15.44) when compared to participants with personal opioid use (M = 13.89), $t(183) = 2.66$; $p = .009$, indicating a more positive attitude toward opioid addiction and addressing the overdose epidemic among those with no personal opioid use. There were no significant differences in helping behavior, knowledge, attitude towards helping someone with opioid addiction, behavioral skills, reinforcing factors, or enabling factors between these two groups, all $p > .05$.

Differences in knowledge, attitude, behavioral skills, reinforcing factors, enabling factors, and helping behaviors were explored between participants who knew someone who non-medically used opioids and those who did not (Table 2). Knowledge about opioid addiction and the overdose epidemic was significantly higher among participants who knew someone who non-medically used opioids (M = 5.59) when compared to those who did not (M = 4.55), $t(210) = 3.79$; $p < .001$. Attitude toward opioid addiction was also significantly higher among participants who knew someone who non-medically used opioids (M = 14.85) when compared to those who did not (M = 13.56), $t(190) = 2.13$; $p = .035$. Finally, behavioral skills were also significantly higher among participants who knew someone who non-medically used opioids (M = 9.52) when compared to those who did not (M = 7.80), $t(205) = 2.93$; $p = .004$. There were no significant differences in helping behavior, knowledge, attitude towards helping someone with opioid addiction, reinforcing factors, or enabling factors between these two groups, $p > .05$.

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Table 2. Test of group differences in constructs by personal history

Helping behavior	n	Mean	SD	Mean difference	t	p
Personal opioid use	134	6.19	1.99	0.19	0.64	0.521
No personal use	65	6.38	1.90			
Know someone who non-medically uses or abuses opioids	133	6.30	1.83	0.12	0.43	0.666
Does not know someone who non-medically uses or abuses opioids	73	6.18	2.16			
Knowledge						
Personal opioid use	139	5.22	1.87	0.01	0.03	0.978
No personal use	65	5.23	1.86			
Know someone who non-medically uses or abuses opioids	133	5.59	1.66	1.04	3.79	<0.001*
Does not know someone who non-medically uses or abuses opioids	78	4.55	2.07			
Attitude toward opioids						
Personal opioid use	123	13.89	3.71	1.55	2.66	0.009*
No personal use	61	15.44	3.72			
Know someone who non-medically uses or abuses opioids	123	14.85	3.32	1.29	2.13	0.035*
Does not know someone who non-medically uses or abuses opioids	68	13.56	4.31			
Attitude toward helping someone with opioid addiction						
Personal opioid use	136	10.50	2.19	0.41	1.45	0.150
No personal use	64	10.91	1.67			
Know someone who non-medically uses or abuses opioids	132	10.81	1.80	0.49	1.54	0.126
Does not know someone who non-medically uses or abuses opioids	75	10.32	2.41			
Behavioral skills						
Personal opioid use	135	8.53	3.99	1.15	1.84	0.067
No personal use	64	9.69	4.40			
Know someone who non-medically uses or abuses opioids	130	9.52	3.81	1.72	2.93	0.004*
Does not know someone who non-medically uses or abuses opioids	76	7.80	4.47			
Reinforcing factors						
Personal opioid use	134	7.14	3.37	0.32	0.65	0.519
No personal use	65	7.46	3.08			
Know someone who non-medically uses or abuses opioids	131	7.12	3.02	0.40	0.80	0.428
Does not know someone who non-medically uses or abuses opioids	75	7.52	3.68			
Enabling factors						
Personal opioid use	133	8.95	4.75	0.44	0.62	0.537
No personal use	65	9.38	4.50			
Know someone who non-medically uses or abuses opioids	132	9.20	4.48	0.04	0.07	0.946
Does not know someone who non-medically uses or abuses opioids	73	9.15	4.96			

[†]Welch's t-test.; *$p < .05$

Pearson correlation analyses were calculated to determine the relationship between helping behavior and knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors (Table 3). Helping behavior was found to demonstrate significant, weak to moderate positive correlations with attitude towards opioid addiction ($r = .344$; $p < .001$), attitude towards helping someone with an opioid addiction ($r = .527$; $p < .001$), behavioral skills ($r = .487$; $p < .001$), reinforcing factors ($r = .567$; $p < .001$), and enabling factors ($r = .522$; $p < .001$). There was no significant correlation between helping behavior and knowledge about opioid addiction and the overdose epidemic.

Table 3. Zero-order correlation matrix of study variables

Construct	1	2	3	4	5	6	7
1. Helping behavior	-	0.033	0.344**	0.527**	0.487**	0.567**	0.522**
2. Knowledge		-	0.185*	0.064	0.263**	0.097	0.120
3. Attitude: opioid addiction			-	0.276**	0.407**	0.350**	0.431**
4. Attitude: helping someone with opioid addiction				-	0.242**	0.361**	0.273*
5. Behavioral skills					-	0.548**	0.495**
6. Reinforcing factors						-	0.631**
7. Enabling factors							-

A multivariable linear regression model was created to determine the ability of knowledge, attitude, behavioral skills, reinforcing factors, and enabling factors to explain helping behavior (Table 4). The regression model was significant, $F_{(6, 180)} = 26.191$, $p < 0.001$ and explained 44.8% of the variance in helping behavior ($R^2 = .448$). Attitude towards helping someone with opioid addiction ($B = .335$; $p < .001$), behavioral skills ($B = .208$; $p = .003$), reinforcing factors ($B = .190$; $p = .015$), and enabling factors ($B = .195$; $p = .009$) were all significantly associated with helping behavior, where increases in all variables were associated with an increase in helping behavior.

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Table 4. Multiple regression models of helping behavior onto predictor variables

	b	S.E.	B	p	LBCI	UBCI
Knowledge	-0.064	0.057	0.064	0.262	-0.176	0.048
Attitudes: toward opioids	0.017	0.032	0.034	0.599	-0.046	0.079
Attitude: toward helping someone with opioid addiction	0.330	0.058	0.335	< 0.001*	0.215	0.444
Behavioral skills	0.096	0.032	0.208	0.003*	0.033	0.159
Reinforcing factors	0.111	0.045	0.190	0.015*	0.022	0.200
Enabling factors	0.079	0.030	0.195	0.009*	0.020	0.138
Model statistics: Adjusted R^2 = 0.448, $F_{(6, 180)}$ = 26.191, $p < 0.001$						

S.E. = standard error of the estimate; *LBCI* = lower bound of the *95% confidence interval*; *UBCI* = upper bound of the *95% confidence interval*.; *$p < .05$*

Discussion

The findings from the present study have important implications for understanding helping behavior related to opioid addiction and the overdose epidemic. In our study, participants who had never used opioids had more positive attitudes about opioid use when compared to those who had previously used opioids, for prescription and non-prescription reasons. Additionally, people who knew someone who non-medically used opioids demonstrated greater knowledge about opioid addiction, attitudes about opioid addiction, and greater behavioral skills to help someone with an opioid addiction. In the multivariable regression model, we were able to explain a large proportion of variance in helping behavior (44.8%), where attitude towards helping someone with an opioid addiction, behavioral skills, reinforcing factors, and enabling factors were all significantly associated with helping behavior. In the multivariable model, predisposing (i.e., attitude, skills), enabling, and reinforcing factors were all significantly and positively associated with higher helping behavior scores, supporting the utility of the

PRECEDE-PROCEED framework for this analysis and to address helping behavior in future health promotion interventions and programs.

In our sample, 65.3% of participants reported ever using an opioid, for both prescription and non-prescription reasons, and 62.4% reported knowing someone who non-medically used opioids. Although national rates of opioid dispensing have decreased in recent years, from 81.3 prescriptions per 100 persons in 2012 to 43.3 per 100 persons in 2020, some states still report higher than average rates of prescription opioid dispensing [7]. For example, in Kentucky where the data for the present study were collected, the dispensing rate in 2020 was 68.2 per 100 persons, mirroring the proportion of participants in the present study that reported ever using an opioid for both prescription and non-prescription reasons [7]. Additionally, over half of the sample reported personally knowing someone who non-medically used opioids, highlighting the magnitude of the overdose epidemic in this region of the country. This demonstrates that there is a continued need for educational programming and health promotion strategies to combat the overdose epidemic in the United States, especially in areas such as Appalachia, which have been hit the hardest and continue to fall behind other regions of the country in reducing opioid non-medical use and dispensing rates.

There were very few differences between participants in this study that reported previous prescription or non-prescription use of opioid medications and those that did not, but there was a higher attitude towards opioid addiction score among participants who reported no previous use when compared to those who had previously used opioid medication. Items in the attitude toward opioid addiction scale assessed factors such as ability to treat addiction, magnitude of the seriousness of the overdose epidemic, and ability to seek help and manage an addiction. Higher scores on this scale were likely reported among those who had no previous opioid use because

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those participants may not be familiar with the addictive nature of opioid medications and the associated difficulty in overcoming an addiction. It would be important for practitioners and researchers working to address changing attitudes among those who have previous opioid use to increase perceptions of help seeking, management, and seriousness of an opioid non-medical use.

Additional differences were found between participants who knew someone who non-medically used opioids when compared to those who did not personally know someone suffering from opioid addiction. Specifically, participants who knew someone who non-medically used opioids had higher knowledge about opioid addiction and the overdose epidemic, more positive attitude about opioid addiction, and greater behavioral skills to help someone with an opioid addiction (i.e., effective communication, helping with an overdose, referring someone to a health professional). These differences were likely due to their personal experiences or skills they have acquired to potentially assist others with negative outcomes associated with opioid non-medical use, such as an accidental overdose. Additionally, people who did not currently know someone who non-medically used opioids may have been influenced by societal stigma associated with the overdose epidemic, impacting their knowledge and attitude about opioid addiction [29, 40, 41]. Previous research has linked higher levels of stigma toward people who use prescription opioids to increased support for punitive policies, less support for public health and prevention measures, and a decreased motivation to interact with people who use opioids [29, 31, 41]. Like the findings in our study, a recent study among US young adults also found that people with less personal experience with opioid use disorder were more likely to exhibit more negative attitudes towards opioid use [40].

These findings align with current strategies to curb the overdose epidemic in the US, including the use naloxone-based interventions to equip bystanders to intervene and administer life-saving medical treatment during an overdose [27, 28]. A recent review of naloxone-based interventions showed that these interventions are most effective when framed in a harm reduction context supportive of people who use opioids, in communities where Good Samaritan laws are present, and when societal attitudes towards people who non-medically use opioids are positive [27]. Additionally, aside from encouraging reductions in dispensing of opioid medications, current public health strategies rely on interpersonal relationships and familial influence to help combat the overdose epidemic [28]. This finding is promising but also shows a need to educate people that do not currently know someone who non-medically uses opioids to respond effectively when interacting with individuals with an opioid addiction or in response to an overdose. Future research should continue to explore attitude, knowledge, and skills, to develop strategies to increase these important predisposing factors to opioid helping behavior for the general population.

In the multivariable regression model, we found that predisposing factors, including attitude and behavioral skills to help someone with an opioid addiction, as well as reinforcing and enabling factors were significantly associated with increased helping behavior in our sample. The combination of these variables also explained a high proportion of the variance in helping behavior (44.8%), which is substantial for psychosocial and health behavior research [42]. This finding is important for two reasons. One, this finding supports the utility of the PRECEDE-PROCEED framework for designing, implementing, and evaluating intervention strategies to address opioid addiction in a population with high prevalence of opioid-related morbidity and mortality. Second, these findings provide insight into specific behavioral antecedents that can be

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incorporated into tailored educational interventions that directly align with the needs of this this population of interest.

Predisposing factors, specifically attitude and skills to help someone with an opioid addiction, were associated with greater helping behavior in this sample. These factors could be incorporated into educational programming to increase helping behavior to address opioid addiction. In addition to addressing changes in knowledge and attitude through educational strategies, public health education professionals should include public training on how to effectively help someone with a drug overdose, such as using take-home naloxone [27, 28]. These types of trainings have been shown to be an effective strategy to increase skills and helping behavior in other populations, particularly when structured in harm reduction context and when delivered in a peer-to-peer format [43]. Peer-to-peer interventions are important strategies to address the overdose epidemic, as these programs help to engage individuals in addressing the overdose epidemic and aid in rebuilding trust in the healthcare system [30, 44]. Public health professionals should consider implementing naloxone-based trainings, an important predisposing skill to address potential opioid-related overdoses, in communities substantially impacted by the overdose epidemic in order to equip all members of the community to intervene with bystander or peer-to-peer intervention.

Reinforcing factors, operationalized in this study as social support from a variety of sources, was also associated with increased helping behavior in our sample. Reinforcing factors may include improvements in peer, familial, and healthcare provider support to help someone with an opioid addiction. Research has shown that familial as well as healthcare provider support can be a promising strategy to increase the likelihood of helping people with an opioid addiction [45, 46]. Research on familial support has shown that interventions should use strategies to

increase attitude and knowledge toward prescription opioid non-medical use as well as provide resources and develop skills to help facilitation prevention [45]. Findings from a recent comprehensive literature review on the opioid crisis from the perspective of the healthcare system also supported the need for improved education of healthcare providers, including upstream educational programs that prepare healthcare providers to better combat the opioid crisis [46]. Public health professionals should work to increase these interpersonal relationships to better equip peers, family members, and healthcare professionals to provide appropriate support to those impacted by opioid addiction.

Lastly, the presence of enabling factors in the individual's environment, including community organizations, faith-based organizations, healthcare organizations, and other resources, were associated with helping behavior in this sample. This finding emphasizes the need to not only address individual-level factors, such as knowledge and attitude, but also to improve the resources available in the communities where people live. Research on contextual factors that may impact the success of community-based interventions to address opioid use disorders has shown that the health services environment, including the availability and access to substance use services, is an important determinant to successfully addressing the overdose epidemic [47]. In addition to addressing important predisposing and reinforcing factors, public health professionals working in areas heavily impacted by the overdose epidemic should consider improving the community-level resources available to improve helping behavior among community members.

This study's focus on helping behaviors presents only one facet of opioid-related harm reduction. Illicit fentanyl is the most proximal causal factor for opioid-related overdose [8, 48]. The manufacturing and dissemination of illicit fentanyl, as well as other highly toxic and

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incredibly harmful synthetic drugs such as P2P methamphetamine is highly profitable [49]. As such, we will not be able to eliminate the presence of these drugs and their associated harms without continued policy change related to how drugs, those who use, and their treatment is viewed in the United States (i.e., legalization, decriminalization, and medication assisted treatment) [50-54].

Limitations

The current study is not without limitations. First, utilizing intercept sampling procedures, data were obtained from a sample of mall patrons. Therefore, the participants in the present study may not be representative of the larger population in the surrounding Tri-State Appalachian counties, limiting the generalizability of the study findings. Additionally, due to the intercept sampling strategy used in this study, there may be potential bias in the self-reporting of opioid use in a public setting with a researcher who has not built rapport with the participant. Further, findings from this study should be interpreted as relevant to the sample recruited for this study and not the public, which limits the generalizability of the findings to the larger population. The sample was also predominantly men and young (18-30 years of age), further limiting the generalizability of the findings to women and older age groups. Second, all data were collected using self-report measures. This limitation may increase the likelihood of response bias, including social desirability, which may have impacted the findings in the analysis. Specifically, social desirability may have prevented some participants from feeling comfortable answering the items related to their personal non-medical use of opioids. Third, the Cronbach's alpha for the attitudes concerning opioid addiction subscale was low, raising concerns about the subscale's internal consistency reliability. As a result, caution should be used while interpreting the results pertaining to this variable. Last, because the study was cross-sectional, it was impossible to make

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any conclusions about causation or directionality between the variables. Future studies should employ longitudinal study designs or implement interventions to overcome this limitation.

Conclusions

The findings of this study provide crucial information about the characteristics that predispose, enable, and reinforce helpful behavior among inhabitants in Appalachia, an area that has been severely touched by the US overdose epidemic. Our findings highlight important factors, including attitude, skills, reinforcing, and enabling factors, that can directly inform the development of intervention strategies to address helping behavior related to opioid addition. Public health professionals working to address the overdose epidemic should consider all influences on helping behavior, including individual-level predisposing factors, interpersonal reinforcing factors, and community-level enabling factors to develop intervention strategies and programs that directly reflect the needs of their population of interest. A logical next step in this stream of research is the development and testing of intervention strategies to address the predisposing, enabling, and reinforcing factors associated with helping behavior for opioid non-medical use. Future research should aim to translate these findings to the development of public health programming. Since the findings from this study may only be generalizable to people residing in the Tri-County Appalachian region of the United States where the data were obtained, more research is needed to explore characteristics related with helping behavior in other groups of interest.

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics statements

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Patient consent for publication

Not required

Consent obtained directly from patient(s)

All included patients provided oral informed consent, and the study protocol was approved by the Ethics Committee at the Lincoln Memorial University (IRB; Protocol #707 V.3).

Authors Contribution

V.K.N. and M.S. contributed to study conceptualization and design; M.S. developed the instrument; P.M.S. and R.W.K. contributed to data collection; V.K.N. and R.E.D. contributed to data analysis; A.H.W., M.S., R.E.D., P.M.S., R.W.K., D.B., and V.K.N. are responsible for data interpretation; A.H.W., M.S., R.E.D., P.M.S., R.W.K., D.B., and V.K.N. drafted the article or revised it critically for important intellectual content; A.H.W., M.S., R.E.D., P.M.S., R.W.K., D.B., and V.K.N. gave final approval of the version of the article to be published; A.H.W., M.S., R.E.D., P.M.S., R.W.K., D.B., and V.K.N. agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. A.H.W., M.S., R.E.D., P.M.S., R.W.K., D.B., and V.K.N. have read and agreed to the published version of the manuscript.

Conflict of Interest: None

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	2

| Abstract | #1b | Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |

Introduction

| Background / rationale | #2 | Explain the scientific background and rationale for the investigation being reported | 3-6 |
| Objectives | #3 | State specific objectives, including any prespecified hypotheses | 6 |

Methods

Study design	#4	Present key elements of study design early in the paper	6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6-7
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	7-11
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	7-11

Bias	[#9](#9)	Describe any efforts to address potential sources of bias	11
Study size	[#10](#10)	Explain how the study size was arrived at	12
Quantitative variables	[#11](#11)	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	11
Statistical methods	[#12a](#12a)	Describe all statistical methods, including those used to control for confounding	11
Statistical methods	[#12b](#12b)	Describe any methods used to examine subgroups and interactions	11
Statistical methods	[#12c](#12c)	Explain how missing data were addressed	11
Statistical methods	[#12d](#12d)	If applicable, describe analytical methods taking account of sampling strategy	6
Statistical methods	[#12e](#12e)	Describe any sensitivity analyses	NA

Results

| Participants | [#13a](#13a) | Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow- |

up, and analysed. Give information separately for for exposed
and unexposed groups if applicable.   12

Participants   #13b   Give reasons for non-participation at each stage   7

Participants   #13c   Consider use of a flow diagram   NA

Descriptive data   #14a   Give characteristics of study participants (eg demographic,
clinical, social) and information on exposures and potential
confounders. Give information separately for exposed and
unexposed groups if applicable.   12

Descriptive data   #14b   Indicate number of participants with missing data for each
variable of interest   12-14

Outcome data   #15   Report numbers of outcome events or summary measures.
Give information separately for exposed and unexposed
groups if applicable.   12-14

Main results   #16a   Give unadjusted estimates and, if applicable, confounder-
adjusted estimates and their precision (eg, 95% confidence
interval). Make clear which confounders were adjusted for
and why they were included   11 & 28

Main results   #16b   Report category boundaries when continuous variables were
categorized   26

Main results   #16c   If relevant, consider translating estimates of relative risk into
absolute risk for a meaningful time period   NA

Other analyses   #17   Report other analyses done—e.g., analyses of subgroups
and interactions, and sensitivity analyses   11

Discussion

| Key results | #18 | Summarise key results with reference to study objectives | 14 |

Limitations #19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.   19-20

Interpretation #20 Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.   19-20

Generalisability #21 Discuss the generalisability (external validity) of the study results   19-20

Other Information

Funding #22 Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based   21

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