Discover Public Health

RESEARCH Open Access

Three-year trends in community opioid use disorder stigma in a rural Tennessee county

Kahler W. Stone[1*], David I. Olatunji[1], Sara V. Rodriguez Molina[1], Michael Ayalon[2], Angela S. Bowman[1] and Cynthia Chafin[2]

*Correspondence:
Kahler W. Stone
kahler.stone@mtsu.edu
[1]Department of Health Sciences, Middle Tennessee State University, Murfreesboro, TN, USA
[2]Center for Health and Human Services, Middle Tennessee State University, Murfreesboro, TN, USA

Abstract

Background Stigma toward people with opioid use disorder (OUD) limits treatment engagement, particularly in underserved rural communities. This study examined three-year trends in OUD stigma among community members in a rural Tennessee county served by a federal opioid response program.

Methods Repeated cross-sectional surveys at the Wilson County and Tennessee State Fair assessed 1,150 adults in 2022 ($n = 393$), 2023 ($n = 386$), and 2024 ($n = 371$). A 12-item scale measured four stigma domains (dangerousness, blame, social distance, fatalism) and two knowledge/attitude items. Covariate-adjusted prevalences were estimated by marginal standardization from logistic models adjusted for age, gender, race/ethnicity, and county of residence, with proportional-odds models fitted to the ordinal scores.

Results Acceptance of medication-assisted treatment (MAT) rose from an adjusted 65.7% (95% CI: 60.7–70.5) in 2022 to 74.1% (69.6–78.5) in 2024 (p-trend = 0.017). Fatalism increased over the same period, from 24.3% (19.9–28.7) to 31.6% (27.0–36.6) (p-trend = 0.029). Social distance was elevated in 2023 (52.5%, 47.2–57.6, vs. 42.7%, 37.4–47.7, in 2022) and returned to baseline by 2024. Dangerousness, blame, and disease recognition did not change. Proportional-odds models produced identical inference.

Conclusions Community attitudes toward OUD treatment improved across three survey years while beliefs about the possibility of recovery worsened. Dangerousness remained the most prevalent stigma domain and was unchanged. Treatment attitudes and recoverability beliefs appear to respond differently and warrant distinct intervention approaches.

Significance This three-year repeated cross-sectional study provides domain-specific evidence of change in community OUD stigma coinciding with Rural Communities Opioid Response Program (RCORP) programming. Acceptance of medication-assisted treatment increased significantly and was sustained, while fatalistic beliefs about recovery increased over the same period. Dangerousness stigma remained the most prevalent domain and did not change. These findings identify beliefs about recoverability as a priority target for community stigma programming in rural settings.

Keywords Opioid use disorder, Stigma, Rural health, Temporal trends, Rural communities opioid response program, Medication-assisted treatment

© The Author(s) 2026. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

1 Introduction

Drug overdose deaths in the United States reached 79,384 in 2024, with opioids involved in approximately 68% of all overdose fatalities [1]. While overall overdose mortality declined 26% from 2023 to 2024 (the largest single-year decrease in the past decade), rural communities continue to bear a disproportionate burden of opioid-related harm, although rural–urban gaps in overdose mortality appear to be narrowing [1]. In Tennessee, the overall drug overdose mortality rate declined 31% between 2023 and 2024, the largest single-year decrease on record [2]. Prescription opioid overdose death rates are approximately 13% higher in rural counties than in urban counties, and access to evidence-based treatment in non-metropolitan areas lags far behind need [3]. In Tennessee, the opioid overdose death rate was 52.3 per 100,000 in 2023, approximately 67% above the national average, with fentanyl and synthetic opioids involved in 77% of overdose deaths [4]. Wilson County, a semi-rural county east of Nashville, has been served since 2020 by the federally funded Rural Communities Opioid Response Program (RCORP), which supports community education, harm reduction, and expanded access to medication-assisted treatment (MAT).

Despite the availability of evidence-based pharmacotherapies including buprenorphine, naltrexone, and methadone, treatment uptake in rural areas remains critically low [5]. An estimated 56% of rural counties in the U.S. lack a single buprenorphine provider, leaving large portions of the rural population in treatment deserts [6]. Stigma is a well-documented contributor to this treatment gap and operates through several pathways. Public attribution of OUD to personal moral failure rather than to a medical condition is associated with reduced support for evidence-based treatment policies and for the expansion of treatment infrastructure [7–9]. Anticipated judgment from family, employers, and neighbors deters disclosure of use and delays care seeking, and stigma directed specifically at medication treatment discourages initiation and continuation of the pharmacotherapies with the strongest evidence for reducing mortality [10–12]. In rural communities these effects are compounded by limited anonymity, where treatment seeking is more readily observed by others, and by concentrated provider shortages that leave few alternatives when a local source of care is perceived as stigmatizing [13, 14].

Social stigma toward people with OUD is multidimensional, encompassing stereotypes about dangerousness and unpredictability, attribution of personal blame, desire for social distance, and fatalistic views about the capacity for recovery [15–17]. Link and Phelan characterize stigma as the co-occurrence of labeling, stereotyping, separation, status loss, and discrimination within a context of unequal power, a framework that treats these domains as related but distinct components rather than a single underlying attitude [16]. Dangerousness concerns perceived unpredictability and threat to community safety; blame concerns causal attribution and moral responsibility for the condition; social distance concerns willingness to enter social roles and relationships with an affected person, from working alongside them to accepting them into a family; and fatalism concerns beliefs about whether recovery is achievable at all. Each domain carries distinct implications for intervention design: blame responds to disease-model framing, whereas dangerousness beliefs and social distance may be more resistant and require contact-based or narrative approaches [18, 19]. Published baseline data from Wilson County document measurable stigma across all four domains among both community members and law enforcement [20]. Community surveys elsewhere in rural Appalachia

have found a similar configuration, in which most respondents accept that OUD is a genuine illness while dangerousness beliefs persist alongside that acceptance [21].

Temporal surveillance of community stigma remains limited. Most published studies are single-wave and cross-sectional, making it difficult to assess whether attitudes are improving, stable, or worsening in response to intervention. Repeated cross-sectional designs, in which independent community samples are measured with a consistent instrument across multiple time points, provide a feasible approach for estimating population-level stigma trends [19]. This study examined three-year trends in OUD stigma domains and knowledge/attitude items among community members in Wilson County, Tennessee, using data collected at the Wilson County and Tennessee State Fair from 2022 to 2024, coinciding with ongoing RCORP programming in the county.

2 Methods

2.1 Setting and program context

Wilson County, Tennessee, a semi-rural county east of Nashville, received federal opioid response funding through sequential Health Resources and Services Administration planning and implementation awards spanning September 2020 through August 2024. Program activities were carried out by the Middle Tennessee State University Center for Health and Human Services with four consortium partners, including the DrugFree WilCo community coalition, and were organized around prevention, treatment, and recovery, with stigma reduction as a cross-cutting objective. Stigma reduction activities consisted of peer-led harm reduction training for local law enforcement in January 2022, educational sessions for health care providers and other community professionals, and a "Reduce the Stigma" billboard campaign placed in the county in 2022 and again in 2024. Annual program reports are available through the MTSU Center for Health and Human Services [22].

The three community survey waves were conducted in August 2022, August 2023, and August 2024, placing all measurements within the implementation period. Program activities, including the initial billboard placement, were underway approximately eleven months before the first survey. The 2022 wave therefore represents a mid-program measurement rather than a pre-intervention baseline, and comparisons across waves estimate change during ongoing programming rather than change attributable to program initiation.

2.2 Study design and sample

This study used a repeated cross-sectional design with independent community surveys conducted in 2022, 2023, and 2024. Surveys were administered at the Wilson County Fair – Tennessee State Fair (Lebanon, TN), the venue's official designation reflecting its dual role as the county fair for Wilson County and the State Fair of Tennessee. Adult fairgoers (age ≥ 18 years) were recruited via convenience sampling each year; research team members approached individuals at designated booths and invited participation. In all three years, participants could complete the survey by paper or by scanning a QR code to access an electronic version. Beginning in 2023, small cards displaying the QR code were distributed to individuals when they were initially approached, to facilitate completion following departure from the fair venue. Because of the electronic response option, the survey was held open for two weeks following the fair's final day each year

to allow participants who preferred to respond remotely. Participation was voluntary and no compensation was provided. The study was reviewed by the Middle Tennessee State University Institutional Review Board (Protocol 22-1072 1q) and determined to be exempt.

The fair was selected as the recruitment venue because it is the largest annual public gathering in Wilson County and draws a broad cross-section of county residents along with attendees from surrounding counties, permitting community attitudes to be sampled outside of clinical, treatment, or justice-involved settings. The construct of interest is public stigma, defined as attitudes held by community members toward people with OUD, rather than the internalized or anticipated stigma experienced by people who use drugs. Sampling the general adult public is therefore aligned with the construct and with the community-level focus of the programming under way in the county. Eligibility was limited to adults 18 years of age or older, confirmed by respondent acknowledgment during the consent process, and no other inclusion or exclusion criteria were applied. Residence in Wilson County was not required, which permitted comparison between county residents and attendees from surrounding areas.

Respondents completed the instrument themselves rather than being interviewed, with research staff present throughout to explain the study and answer questions as they arose. Several quality controls were applied before analysis. Responses missing entire sections, left open without finalization, or lacking complete consent authorization were excluded. For responses collected electronically, records were retained only if all initial consent acknowledgments and the final consent item were affirmed and the questionnaire was marked complete. Refusals were not recorded at the point of recruitment, so a response rate cannot be calculated.

2.3 Outcomes

OUD stigma was assessed using a questionnaire adapted from instruments developed by Kruis and colleagues and Davis and colleagues to measure stigma toward people who use drugs [23–25]. The identical instrument was administered to community members and law enforcement officers in a previously published cross-sectional analysis of the 2022 wave [20]. Respondents rated each statement on a 5-point Likert scale (1 = Strongly Agree, 2 = Agree, 3 = Not Sure, 4 = Disagree, 5 = Strongly Disagree). Seventeen items were administered. Twelve measured four stigma domains: Dangerousness (4 items; e.g., "People who use heroin opioids are a threat to the safety of our community"), Blame (1 item; "Persons addicted to heroin and/or opioids are usually responsible for their own condition"), Social Distance (6 items; e.g., "It would bother me to live near a person who used heroin or opioids"), and Fatalism (1 item; "Most people who become addicted to heroin or opioids are addicts for life"). Two items measured knowledge and attitudes toward treatment, and three assessed perceptions of the typical drug user and were not analyzed in the present study. Full wording for all analyzed items is provided in ESM 1. Lower scores reflect stronger endorsement of stigmatizing attitudes. Internal consistency was acceptable for both multi-item domains (Cronbach's $\alpha = 0.81$ for Dangerousness, $\alpha = 0.79$ for Social Distance) and for the combined 12-item stigma scale ($\alpha = 0.85$).

The instrument uses both person-first and non-person-first terminology, including "addict" and "addicted," mirroring language commonly encountered in public discourse

and media. This wording was retained from the source instruments to elicit responses to the terms respondents encounter outside the survey setting. Such language is itself stigmatizing, and its use here is confined to measurement.

Two additional items assessed knowledge and attitudes toward OUD and its treatment: "Drug abuse is a disease" (disease recognition) and "Medical assisted treatment (MAT) programs can be an essential tool in aiding in treatment and preventing overdose deaths" (MAT acceptance). For these items, agreement (lower scores) reflects a positive, anti-stigma orientation rather than a stigmatizing one.

Binary high-stigma outcomes were constructed for each domain. For multi-item domains (Dangerousness and Social Distance), high stigma was defined as a domain mean score of ≤ 2.5, indicating that a respondent on average agreed with stigmatizing statements. For single-item domains (Blame and Fatalism), high stigma was defined as a response of ≤ 2 (Agree or Strongly Agree). One Social Distance item, comfort with a person with OUD marrying into one's family, was reverse-coded (6 minus the original response) prior to computing the domain mean, so that higher scores consistently reflected greater stigma across all items. For the two knowledge/attitude items, the binary outcome was endorsement of the positive statement (response ≤ 2 = Agree or Strongly Agree with the pro-treatment or disease-model statement).

2.4 Sociodemographic characteristics

Participant demographics included age (continuous, years), gender (man, woman, or other/non-binary), and race/ethnicity, which was collapsed to a binary indicator (White vs. non-White) due to small cell sizes in racial/ethnic minority groups. County of residence was dichotomized as Wilson County resident vs. non-resident. Billboard recall was assessed in all three survey years by asking whether the respondent had seen any of the DrugFree WilCo billboards displayed in Wilson County in the past year, dichotomized as any versus no recall. A single item asking whether the respondent or a close loved one had ever been affected by substance use was administered in 2023 and 2024 only; this item is described descriptively and was not included in primary cross-year regression models due to its limited availability.

2.5 Data analysis

Sample characteristics were summarized by survey year using means and standard deviations for continuous variables and frequency counts with column percentages for categorical variables. Between-year differences were assessed using analysis of variance (age) and chi-square tests (categorical variables).

Binary high-stigma outcomes were modeled with logistic regression, with survey year entered as a categorical factor and 2022 as the reference year. All models were adjusted for age (continuous), gender, race/ethnicity (binary), and Wilson County residence. Because the samples differed across years in measured characteristics, results are presented primarily as covariate-adjusted prevalence rather than as odds ratios. Predicted probabilities were obtained for every respondent under each survey year and averaged, a marginal standardization that expresses the fitted model on the probability scale and yields prevalence estimates comparable across waves. Confidence intervals for these estimates are percentile bootstrap intervals from 2,000 replicates. Adjusted odds ratios

from the same models are reported in ESM 4. A separate model treating year as a continuous predictor provided p-values for linear trend (p-trend).

To avoid relying on the binary classification thresholds, proportional-odds ordinal logistic models were fitted to the full five-point response scale for each domain and knowledge item, adjusted for the same covariates. Complete-case analysis was applied for each outcome; participants missing the outcome or any covariate were excluded from that model.

Two prespecified subgroup analyses were conducted. The first was restricted to Wilson County residents, because the venue draws attendees from surrounding counties and the proportion of Wilson County residents differed across survey years; restricting to residents isolates the population exposed to county-level programming. The second compared paper with electronic administration, because the QR code option was promoted with distributed cards beginning in 2023 and mode of administration is therefore partly confounded with survey year. That comparison was restricted to 2023 and 2024, since all 2022 responses were recorded under a single distribution channel although both formats were in use that year. Differences were anticipated in both subgroups, and each was examined to determine whether composition or response mode accounted for observed between-year differences rather than to test the robustness of the primary estimates.

All analyses were conducted in R version 4.5.2. Logistic models were fitted with glm() in the base stats package and proportional-odds models with polr() from the MASS package.

3 Results

3.1 Sample characteristics

A total of 1,150 individuals completed surveys across the three study years: 393 in 2022, 386 in 2023, and 371 in 2024 (Table 1). The sample was predominantly female (61.3%) and White (78.8%). Significant year-to-year differences were observed in age distribution ($p < .001$) and county of residence ($p < .001$). The 2023 sample was on average seven years younger than the 2022 cohort (mean age 34.9 years, SD = 11.8 vs. 42.7 years, SD = 15.3); the 2024 sample mean age was 38.0 years (SD = 12.7). Wilson County residents comprised 55.0% of the 2022 sample, 40.7% of the 2023 sample, and 37.2% of the 2024 sample. Billboard recall did not differ significantly across years (41.2% overall; $p = .874$).

3.2 Temporal trends in stigma domains and knowledge/attitudes

Covariate-adjusted prevalence estimates for each outcome and survey year are presented in Table 2 and depicted in Fig. 1. Complete-case sample sizes ranged from 1,093 to 1,118 depending on the outcome. Adjusted odds ratios from the same models are provided in ESM 4, and complete response distributions for all analyzed items by survey year are provided in ESM 2. MAT acceptance rose from an adjusted prevalence of 65.7% (95% CI: 60.7–70.5) in 2022 to 73.2% (68.5–77.6) in 2023 and 74.1% (69.6–78.5) in 2024. The increase was present in both follow-up years (2023 vs. 2022: aOR = 1.43, 95% CI: 1.03–1.99, $p = .033$; 2024 vs. 2022: aOR = 1.50, 95% CI: 1.08–2.08, $p = .016$), with a significant linear trend (p-trend = 0.017). Fatalism increased across the same period, from 24.3% (19.9–28.7) in 2022 to 27.4% (22.9–32.2) in 2023 and 31.6% (27.0–36.6) in 2024 (2024 vs. 2022: aOR = 1.45, 95% CI: 1.04–2.02, $p = .030$; p-trend = 0.029).

Table 1 Sample characteristics by survey year, Wilson County and Tennessee State Fair, 2022–2024

Characteristic	Overall (*N* = 1,150)	2022 (*n* = 393)	2023 (*n* = 386)	2024 (*n* = 371)	*p*
Age, mean (SD)	38.5 (13.7)	42.7 (15.3)	34.9 (11.8)	38.0 (12.7)	< 0.001
Age group, n (%)					< 0.001
18–29	329 (29.2)	82 (21.6)	144 (38.0)	103 (28.0)	
30–39	322 (28.4)	104 (27.4)	105 (27.9)	112 (30.1)	
40–49	222 (19.7)	67 (17.6)	79 (21.3)	75 (20.4)	
50+	256 (22.7)	127 (33.4)	49 (12.9)	80 (21.7)	
Gender, n (%)					0.444
Woman	695 (61.3)	234 (60.6)	240 (63.2)	221 (59.9)	
Man/Other	439 (38.7)	152 (39.4)	140 (36.8)	148 (40.1)	
Race/Ethnicity, n (%)					0.164
White	892 (78.8)	301 (78.4)	296 (77.9)	296 (80.2)	
Black/African American	116 (10.2)	44 (11.5)	37 (9.8)	35 (9.5)	
Hispanic/Latinx	19 (1.7)	5 (1.3)	3 (0.8)	11 (3.0)	
Other/Multiracial	63 (5.6)	21 (5.5)	27 (7.1)	15 (4.1)	
Asian/Pacific Islander	9 (0.8)	5 (1.3)	3 (0.8)	1 (0.3)	
Prefer not to say	33 (2.9)	8 (2.1)	14 (3.7)	11 (3.0)	
Wilson County resident, n (%)					< 0.001
Yes	511 (44.4)	216 (55.0)	157 (40.7)	138 (37.2)	
No	642 (55.6)	177 (45.0)	228 (59.1)	237 (63.2)	
Billboard recall, n (%)					0.874
Recall	473 (41.7)	159 (41.2)	162 (42.7)	152 (41.1)	
No recall	662 (58.3)	227 (58.8)	217 (57.3)	218 (58.9)	

Values are n (%) unless otherwise noted. p-values are from analysis of variance (age) or chi-square tests (categorical variables). RCORP = Rural Communities Opioid Response Program

Table 2 Covariate-adjusted prevalence of opioid use disorder stigma outcomes by survey year, 2022–2024

Outcome	2022% (95% CI)	2023% (95% CI)	2024% (95% CI)	*p*-trend
Dangerousness	69.6 (64.9–74.4)	74.6 (69.8–78.9)	69.1 (64.2–73.8)	0.843
Blame	43.9 (38.9–49.1)	46.8 (41.5–52.1)	38.9 (33.8–43.7)	0.154
Social distance	42.7 (37.4–47.7)	52.5 (47.2–57.6)	44.8 (39.6–49.8)	0.641
Fatalism	24.3 (19.9–28.7)	27.4 (22.9–32.2)	31.6 (27.0–36.6)	0.029
Disease recognition	68.9 (63.9–73.6)	69.7 (64.8–74.2)	69.0 (64.1–73.7)	0.973
MAT acceptance	65.7 (60.7–70.5)	73.2 (68.5–77.6)	74.1 (69.6–78.5)	0.017

Values are covariate-adjusted prevalence estimates (%) with 95% confidence intervals, obtained by marginal standardization from logistic models adjusted for age, gender, race/ethnicity, and Wilson County residence. Confidence intervals are percentile bootstrap intervals from 2,000 replicates. Statistical comparisons between years are from the fitted models and are reported in ESM 4; they are not inferred from overlap between the intervals shown here. CI = confidence interval; MAT = medication-assisted treatment

Social distance was elevated in 2023, at an adjusted prevalence of 52.5% (47.2–57.6) compared with 42.7% (37.4–47.7) in 2022 (aOR = 1.49, 95% CI: 1.10–2.01, p = .010), and returned to 44.8% (39.6–49.8) in 2024, which did not differ from baseline (aOR = 1.09, 95% CI: 0.81–1.47, p = .574; p-trend = 0.641). Dangerousness was the highest-prevalence domain in all three years, at 69.6%, 74.6%, and 69.1%, with no significant change in either follow-up year (p-trend = 0.843). Blame declined from 43.9% in 2022 to 38.9% in 2024, but the change did not reach significance (aOR = 0.81, 95% CI: 0.60–1.09, p = .168; p-trend = 0.154). Disease recognition was stable throughout, at 68.9%, 69.7%, and 69.0% (p-trend = 0.973).

Proportional-odds models fitted to the ordinal domain and item scores reproduced the same three findings (Table 3). Because lower scores indicate stronger agreement, an odds ratio below 1.0 denotes a shift toward greater agreement with the statement. Relative to

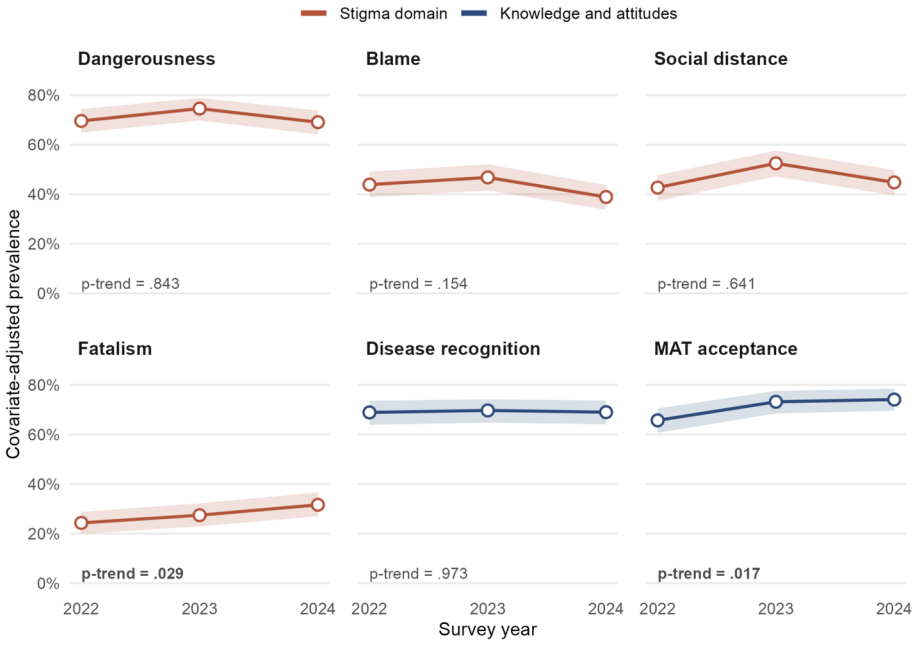

Fig. 1 Covariate-adjusted prevalence of six opioid use disorder stigma outcomes, Wilson County and Tennessee State Fair, 2022–2024. Points are prevalence estimates obtained by marginal standardization from logistic models adjusted for age, gender, race/ethnicity, and Wilson County residence; bands are 95% percentile bootstrap confidence intervals from 2,000 replicates. Colour distinguishes outcomes by direction of benefit: for the four stigma domains a higher value indicates greater stigma, whereas for disease recognition and MAT acceptance a higher value indicates a more favourable orientation. High stigma is defined as a domain mean of 2.5 or below for dangerousness and social distance and an item score of 2 or below for blame and fatalism. p-trend is from a model with survey year entered as a continuous predictor and is shown in bold where $p < .05$. OUD = opioid use disorder; MAT = medication-assisted treatment

Table 3 Proportional-odds models for change in ordinal stigma and knowledge scores by survey year, 2022–2024

Outcome	OR 2023 vs. 2022 (95% CI)	*p*	OR 2024 vs. 2022 (95% CI)	*p*
Dangerousness	0.97 (0.73–1.29)	0.839	1.23 (0.93–1.63)	0.144
Blame	0.90 (0.69–1.17)	0.425	1.21 (0.93–1.58)	0.148
Social distance	0.71 (0.54–0.93)	0.014	0.90 (0.69–1.18)	0.458
Fatalism	0.87 (0.67–1.14)	0.321	0.73 (0.56–0.95)	0.020
Disease recognition	0.95 (0.72–1.24)	0.688	0.98 (0.75–1.28)	0.878
MAT acceptance	0.74 (0.56–0.97)	0.032	0.72 (0.55–0.94)	0.016

Odds ratios are from proportional-odds ordinal logistic models adjusted for age, gender, race/ethnicity, and Wilson County residence, with 2022 as the reference year. Items were scored 1 = Strongly Agree through 5 = Strongly Disagree, so an odds ratio below 1.0 indicates a shift toward stronger agreement with the statement. For the stigma domains this denotes greater stigma; for disease recognition and MAT acceptance it denotes a more favourable orientation. CI = confidence interval; MAT = medication-assisted treatment

2022, 2024 responses shifted toward greater agreement that medication-assisted treatment is an essential tool (OR = 0.72, 95% CI: 0.55–0.94, p = .016) and toward greater agreement that people who become addicted remain addicted for life (OR = 0.73, 95% CI: 0.56–0.95, p = .020). The 2023 social distance elevation was likewise present (OR = 0.71, 95% CI: 0.54–0.93, p = .014). No other comparison reached significance.

Among the covariates, women had higher odds of high dangerousness stigma (aOR = 1.46, 95% CI: 1.12–1.90, p = .005) and lower odds of high blame (aOR = 0.70, 95% CI: 0.55–0.89, p = .004) than men and respondents of other gender identities. White respondents had higher odds of high social distance (aOR = 1.39, 95% CI: 1.06–1.82, p

= .018) and of MAT acceptance (aOR = 1.44, 95% CI: 1.08–1.92, p = .014). Older age was associated with marginally higher odds of high dangerousness stigma (aOR = 1.01 per year, 95% CI: 1.00–1.02, p = .050) and was not associated with any other outcome. Wilson County residence was not independently associated with any outcome. Complete model output for all covariates is provided in ESM 3.

3.3 Subgroup analyses

Among Wilson County residents, the increase in MAT acceptance was larger than in the full sample (2023 vs. 2022: aOR = 2.12, 95% CI: 1.29–3.50, p = .003; 2024 vs. 2022: aOR = 2.07, 95% CI: 1.25–3.42, p = .005; n = 480). The 2023 social distance elevation was attenuated and did not reach significance in this subgroup (aOR = 1.37, 95% CI: 0.88–2.14, p = .161), and fatalism showed the same upward direction without reaching significance (2024 vs. 2022: aOR = 1.51, 95% CI: 0.91–2.51, p = .114).

Comparison by survey mode was possible only for 2023 and 2024. Relative to electronic respondents, those completing paper forms had lower odds of high social distance (aOR = 0.73, 95% CI: 0.53–1.00, p = .047) and of disease recognition (aOR = 0.71, 95% CI: 0.50–1.00, p = .048). The remaining four outcomes did not differ by mode.

4 Discussion

Across three survey years coinciding with RCORP programming in Wilson County, Tennessee, two of six outcomes changed and four did not. Acceptance of medication-assisted treatment rose by approximately 8% points and remained elevated in both follow-up years. Fatalistic belief that people who develop opioid use disorder remain addicted for life rose by approximately 7% points over the same period. Social distance was elevated in 2023 and returned to baseline by 2024. Dangerousness, blame, and disease recognition did not change. These findings extend the Stone et al. [20] cross-sectional baseline from Wilson County by characterizing how community attitudes moved across three years of ongoing programming.

The two changes run in opposite directions, and the contrast between them is the central finding of this study. Community beliefs about whether treatment works improved while beliefs about whether people recover deteriorated. These are related but distinct judgments: the first concerns the efficacy of an intervention, the second the prognosis of the condition. Evidence from the mental illness stigma literature indicates that they respond to different inputs. Pescosolido et al. [19] found that a decade of increasing public adoption of neurobiological explanations for schizophrenia, depression, and alcohol dependence was largely unrelated to reductions in perceived dangerousness or desire for social distance. A meta-analysis of experimental studies by Kvaale et al. [26] identified the same dissociation more directly, finding that biogenetic explanations of mental disorder reduced blame while increasing prognostic pessimism, the belief that recovery is unlikely. Kelly et al. [17] reported a parallel pattern for opioid-related terminology in a national sample, in which framing addiction as a chronically relapsing brain disease lowered perceived recoverability while raising perceived need for continuing care. Information establishing that a condition is medically treatable does not by itself establish that people who have it get better, and the present findings are consistent with community education having achieved the former without the latter.

MAT acceptance showed the clearest improvement, consistent with RCORP programming that emphasized community education about the safety and effectiveness of pharmacotherapy for OUD. Community-level beliefs about medication treatment shape the social context in which patients initiate and sustain care, and stigma from family and community contacts toward medication treatment is a documented barrier to initiation and adherence [8, 10, 11]. Stigma attached to the treatment itself is conceptually distinct from stigma attached to the condition, and the two need not move together [12]. The increase was larger among Wilson County residents than in the full sample, which is the direction expected if county-level programming contributed, although this design cannot establish that it did. Because medication treatment is the domain in which attitudes moved, it may also be the most viable channel for broader stigma messaging. Education that already reaches the community around pharmacotherapy could carry content addressing recovery expectations and perceived dangerousness, neither of which changed.

Dangerousness was the most prevalent domain in all three years, endorsed by roughly seven in ten respondents, and did not change. Social distance was elevated in 2023 and returned to baseline in 2024. The 2023 elevation persisted after covariate adjustment and was attenuated in the Wilson County subgroup, which suggests it reflects the composition of that year's sample at least in part; that cohort was on average eight years younger and included 17% points fewer Wilson County residents than the 2022 sample. Social distance is a composite domain capturing willingness to work with, live near, befriend, socialize with, vote for, and marry a person with OUD, and both it and dangerousness are sensitive to perceived personal threat and to prior contact with affected individuals [16]. Neither moved across three years of programming built primarily on information. Programming that directly targets threat perception, through structured contact with people in recovery, narrative exposure, and media advocacy, may be necessary to shift them [27, 28].

Fatalism increased significantly across the study period and showed a significant linear trend. The increase runs counter to the improvement in treatment attitudes and is the more concerning of the two findings, since expectations about recovery shape whether communities invest in recovery support and whether individuals believe treatment is worth beginning. Fatalism is the domain least responsive to education-based programming; shifting recovery expectations requires sustained exposure to observable recovery narratives and direct contact with people in recovery rather than factual information alone [18, 27]. An estimated 22 million Americans self-identify as being in recovery from a substance use problem [29], so the peer contact infrastructure needed to address fatalistic beliefs is widely available. National survey data indicate, however, that the public ranks prescribed medication among the least-credited routes to recovery [30], which suggests that narratives pairing medication treatment with visible recovery may be needed to address both the improving treatment attitudes and the worsening recovery expectations documented here. Recovery storytelling and peer support approaches have shown promise in rural OUD settings [13, 31], and operational examples disseminated through the Rural Communities Opioid Response Program Technical Assistance (RCORP-TA) Resource Portal, including digital storytelling developed in collaboration with people in recovery, provide implementation frameworks adaptable to local grantees.

Two covariate patterns of note, women had higher odds of high dangerousness stigma but lower odds of high blame than other respondents, and White respondents had higher odds of both high social distance and MAT acceptance. Neither pattern is readily

explained by the present data, and both are better treated as observations for replication than as findings with a settled interpretation. They do suggest that community subgroups may differ by domain rather than in overall level of stigma, which would bear on how anti-stigma messaging is targeted.

5 Limitations

This study has several limitations. Convenience sampling at a public fair venue introduces selection bias; fairgoers who complete a stigma survey likely differ from those who decline, and a response rate cannot be calculated. Surveys were completed in the presence of research team members at a public venue and may be subject to social desirability bias, so self-reported attitudes likely underestimate community endorsement of stigmatizing beliefs. Program activities were under way approximately eleven months before the first survey, so the 2022 wave is a mid-program measurement rather than a pre-intervention baseline, and the study cannot describe change from an unexposed starting point. Year-to-year variation in sample composition, particularly the younger and less Wilson County representative 2023 cohort, complicates comparison across waves, and covariate adjustment addresses only observed confounding. Residual confounding from unmeasured variables, including local overdose events, personal OUD history, and media exposure, cannot be excluded. The single-county design limits generalizability, and the absence of a comparison group precludes attributing observed trends to RCORP programming rather than to broader secular change in public attitudes. Survey mode could be distinguished only in 2023 and 2024, since all 2022 responses were recorded under a single distribution channel although both paper and electronic forms were in use that year; within 2023 and 2024, paper respondents reported lower social distance and lower disease recognition than electronic respondents, so mode differences cannot be fully separated from year differences in the earlier wave. Internal consistency of the multi-item domains was acceptable, but the scale has not been subjected to formal psychometric validation, and no correction for multiple comparisons was applied across the six outcome models. Replication in other rural counties with similar programming is needed before these findings can be generalized.

6 Conclusions

Across three years of community surveys conducted during ongoing RCORP programming, acceptance of medication-assisted treatment increased while fatalistic beliefs about recovery increased alongside it. Dangerousness remained the most prevalent stigma domain and did not change, and social distance was elevated in 2023 without persisting into 2024. The divergence between improving attitudes toward treatment and worsening beliefs about recoverability indicates that these are separate targets, and that education establishing treatment efficacy does not by itself change expectations about who recovers. Beliefs about recoverability warrant explicit attention in community stigma programming, addressed through sustained contact with people in recovery rather than through information alone. Whether the patterns observed here extend beyond a single county, and whether contact-based approaches shift them, will require replication in other rural communities with comparable programming.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12982-026-03049-9.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

Supplementary Material 5.

Acknowledgements

The authors wish to acknowledge the partnership with the Drug Free Wilco coalition and MTSU public health students for their volunteering and data collection during this process.

IRB

Protocol 22-1072 1q, Middle Tennessee State University Institutional Review Board.

Author contributions

Kahler W. Stone: Conceptualization, Methodology, Formal analysis, Writing – Original Draft, Review & Editing, Funding acquisition.David I Olatunji: Methodology, Writing - Review & EditingAngela S. Bowman: Conceptualization, Methodology, Writing - Review & EditingSara V. Rodriguez Molina: Writing - Review & EditingMichael Ayalon: Conceptualization, Writing - Review & Editing, Funding acquisition.Cynthia Chafin: Conceptualization, Methodology, Formal analysis, Writing – Review & Editing, Funding acquisition.

Funding

This work was supported by the Health Resources & Services Administration (HRSA) Rural Communities Opioid Response Program (RCORP) under Grant Nos. G25RH40048 (RCORP-Planning) and GA1RH42913 (RCORP-Implementation).

Data availability

Deidentified survey data supporting these findings are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was reviewed by the Middle Tennessee State University Institutional Review Board (Protocol 22-1072 1q) and determined to be exempt from full board review. Informed consent was obtained from all individual participants included in the study. Participation was voluntary and no compensation was provided. Before beginning the questionnaire, each respondent reviewed an informed consent document and provided affirmative acknowledgment that they had read the document, that the research procedures were clear to them, that they were 18 years of age or older, that they were aware of the potential risks of the study, and that they freely and voluntarily chose to participate with the understanding that they could withdraw at any time without consequence. Respondents completing the electronic version provided the same acknowledgments and a final consent confirmation before the questionnaire was displayed. Responses lacking complete consent authorization were excluded from analysis.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 9 June 2026 / Accepted: 23 September 2026

Published online: 06 October 2026

References

1. National Center for Health Statistics. Drug overdose deaths in the United States, 2023–2024 (NCHS Data Brief No. 549). Centers for Disease Control and Prevention; 2026. https://doi.org/10.15620/cdc/174639.
2. Tennessee Department of Health. Provisional 2024 drug overdose mortality brief. Office of Informatics and Analytics; 2024. https://www.tn.gov/health/health-program-areas/pdo.html.
3. National Center for Health Statistics. Urban–rural differences in drug overdose death rates (NCHS Data Brief 440). Centers Disease Control Prev; 2022. https://www.cdc.gov/nchs/products/databriefs/db440.htm
4. Tennessee Department of Health. 2023 Tennessee drug overdose death report; 2023. https://www.tn.gov/content/dam/tn/health/documents/pdo/death-report/2023_Tennessee_Drug_Overdose_Death_Report.pdf
5. Substance Abuse and Mental Health Services Administration. Key substance use and mental health indicators in the United States: Results from the 2022 National Survey on Drug Use and Health (HHS Publication No. PEP23-07-01-006. NSDUH Series H-58. Center for Behavioral Health Statistics and Quality, SAMHSA; 2023. https://www.samhsa.gov/data/.
6. Mitchell P, Potenza MN, Bhatt M. Geographic disparities in access to medication for opioid use disorder across U.S. census tracts based on treatment utilization behavior. Soc Sci Med. 2022;302:114992. https://doi.org/10.1016/j.socscimed.2022.114992.

7. Barry CL, McGinty EE, Pescosolido BA, Goldman HH. Stigma, discrimination, treatment effectiveness, and policy: Public views about drug addiction and mental illness. Psychiatr Serv. 2014;65(10):1269–72. https://doi.org/10.1176/appi.ps.201400140.
8. Kennedy-Hendricks A, Barry CL, Gollust SE, Ensminger ME, Chisolm MS, McGinty EE. Social stigma toward persons with prescription opioid use disorder: Associations with public support for punitive and public health–oriented policies. Psychiatr Serv. 2017;68(5):462–9. https://doi.org/10.1176/appi.ps.201600056.
9. Taylor BG, Lamuda PA, Flanagan E, Watts E, Pollack H, Schneider J. Social stigma toward persons with opioid use disorder: results from a nationally representative survey of U.S. adults. Subst Use Misuse. 2021;56(12):1752–64. https://doi.org/10.1080/10826084.2021.1949611.
10. Earnshaw VA, Smith LR, Copenhaver MM. Drug addiction stigma in the context of methadone maintenance therapy: an investigation into understudied sources of stigma. Int J Ment Health Addict. 2013;11(1):110–22. https://doi.org/10.1007/s11469-012-9402-5.
11. Pescosolido BA, Martin JK. Stigma as a fundamental hindrance to the United States opioid overdose crisis response. PLoS Med. 2019;16(11):e1002969. https://doi.org/10.1371/journal.pmed.1002969.
12. Madden EF, Prevedel S, Light T, Sulzer SH. Intervention stigma toward medications for opioid use disorder: a systematic review. Subst Use Misuse. 2021;56(14):2181–201. https://doi.org/10.1080/10826084.2021.1975749.
13. Anvari MS, Sacko CA, Atkinson GE, Triplett NS, Kihiuria MW, Sonn MS, et al. Stigma is our most powerful enemy: Understanding opioid use disorder stigma and the role of peer support in rural Maryland. Int J Drug Policy. 2025;143:104924. https://doi.org/10.1016/j.drugpo.2025.104924.
14. Lister JJ, Weaver A, Ellis JD, Himle JA, Ledgerwood DM. A systematic review of rural-specific barriers to medication treatment for opioid use disorder in the United States. Am J Drug Alcohol Abuse. 2020;46(3):273–88. https://doi.org/10.1080/00952990.2019.1694536.
15. Corrigan PW, Kuwabara SA, O'Shaughnessy J. The public stigma of mental illness and drug addiction: Findings from a stratified random sample. J Soc Work. 2009;9(2):139–47. https://doi.org/10.1177/1468017308101818.
16. Link BG, Phelan JC. Conceptualizing stigma. Annu Rev Sociol. 2001;27:363–85. https://doi.org/10.1146/annurev.soc.27.1.363.
17. Kelly JF, Greene MC, Abry A. America's perceptions of opioid related impairment: a national randomized study examining how different individuals may stigmatize addiction in response to different terminology. J Subst Use Addict Treat. 2024;157:209288. https://doi.org/10.1016/j.josat.2023.209288.
18. Corrigan PW, Morris SB, Michaels PJ, Rafacz JD, Rüsch N. Challenging the public stigma of mental illness: A meta-analysis of outcome studies. Psychiatr Serv. 2012;63(10):963–73. https://doi.org/10.1176/appi.ps.201100529.
19. Pescosolido BA, Martin JK, Long JS, Medina TR, Phelan JC, Link BG. A disease like any other? A decade of change in public reactions to schizophrenia, depression, and alcohol dependence. Am J Psychiatry. 2010;167(11):1321–31. https://doi.org/10.1176/appi.ajp.2010.09121743.
20. Stone KW, Chesak GM, Bowman AS, Ayalon M, Chafin C. A cross-sectional study of stigma towards opioid users among rural law enforcement and community members in Tennessee. Harm Reduct J. 2024;21:195. https://doi.org/10.1186/s12954-024-01114-7.
21. Beachler T, Zeller TA, Heo M, Lanzillotta-Rangeley J, Litwin AH. Community attitudes toward opioid use disorder and medication for opioid use disorder in a rural Appalachian county. J Rural Health. 2021;37(1):29–34. https://doi.org/10.1111/jrh.12503.
22. Middle Tennessee State University Center for Health and Human Services. CHHS communications and publications. https://chhs.mtsu.edu/publications/. Accessed 13 Aug 2026.
23. Kruis NE, Choi J, Donohue RH. Police officers, stigma, and the opioid epidemic. Int J Police Sci Manag. 2020;22(4):393–406. https://doi.org/10.1177/1461355720962524.
24. Kruis NE, Merlo AV. A preliminary assessment of stigma in law enforcement officers' responses to opioid overdoses. J Drug Issues. 2021;51(2):301–22. https://doi.org/10.1177/0022042620974076.
25. Davis CS, Johnston J, de Saxe Zerden L, Clark K, Castillo T, Childs R. Attitudes of North Carolina law enforcement officers toward syringe decriminalization. Drug Alcohol Depend. 2014;144:265–9. https://doi.org/10.1016/j.drugalcdep.2014.08.007.
26. Kvaale EP, Haslam N, Gottdiener WH. The 'side effects' of medicalization: a meta-analytic review of how biogenetic explanations affect stigma. Clin Psychol Rev. 2013;33(6):782–94. https://doi.org/10.1016/j.cpr.2013.06.002.
27. Corrigan PW, River LP, Lundin RK, Penn DL, Uphoff-Wasowski K, Campion J, et al. Three strategies for changing attributions about severe mental illness. Schizophr Bull. 2001;27(2):187–95. https://doi.org/10.1093/oxfordjournals.schbul.a006865.
28. Livingston JD, Milne T, Fang ML, Amari E. The effectiveness of interventions for reducing stigma related to substance use disorders: a systematic review. Addiction. 2012;107(1):39–50. https://doi.org/10.1111/j.1360-0443.2011.03601.x.
29. Kelly JF, Bergman B, Hoeppner BB, Vilsaint C, White WL. Prevalence and pathways of recovery from drug and alcohol problems in the United States population: Implications for practice, research, and policy. Drug Alcohol Depend. 2017;181:162–9. https://doi.org/10.1016/j.drugalcdep.2017.09.028.
30. Golan O, Kresovich A, Drymon C, Ducharme L, Flanagan Balawajder E, Borowiecki M, Lamuda P, Taylor B, Pollack H, Schneider J. Public perceptions of opioid misuse recovery and related resources in a nationally representative sample of United States adults. Addiction. 2025;120(2):253–65. https://doi.org/10.1111/add.16692.
31. Judd H, Yaugher AC, O'Shay S, Meier CL. Understanding stigma through the lived experiences of people with opioid use disorder. Drug Alcohol Depend. 2023;249:110873. https://doi.org/10.1016/j.drugalcdep.2023.110873.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.