Substance Use Among US Adults at Midlife: Risk Factors and Protective Factors Among National and Milwaukee Black American Samples

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Objectives: Pain interference and financial insecurity are risk factors for substance use. This study examined whether possible protective factors—religious service attendance, spirituality, and social connectedness—moderate the associations between risk factors and substance use among national and Milwaukee Black American samples of adults at midlife in the United States.

Methods: Participants were adults from the Midlife in the United States Study (MIDUS) national sample (N = 4962) and the Milwaukee Black American sample (N = 866). A sequential modeling approach tested main effects and moderation effects, examining whether possible protective factors (religious service attendance, spirituality, and social connectedness) moderated the associations between risk factors (pain interference and financial insecurity) and substance use.

Results: Our findings revealed different patterns across samples. In the national sample, pain interference (β = 0.11, 95% CI = 0.08, 0.14) and financial insecurity (β = 0.06, 95% CI = 0.03, 0.09) independently predicted substance use risk. Religious service attendance moderated the pain interference-substance use link (β = −0.03, 95% CI = −0.06, −0.002). In the Milwaukee Black American sample, financial insecurity (β = 0.15, 95% CI = 0.08, 0.22), but not pain interference, independently predicted substance use. Spirituality moderated the pain interference-substance use association (β = −0.12, 95% CI = −0.18, −0.05). Religious service attendance, spirituality, and social connectedness did not moderate the financial insecurity-substance use association in either sample.

Conclusions: Religious service attendance and spirituality seem to serve as protective moderators in the association between pain interference and substance use. Faith-based interventions for those with pain interference or substance use may warrant testing.

Key Words: chronic pain, socioeconomic factors, substance-related disorders, religion, spirituality, social support.

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Substance use among middle-aged and older adults is a critical public health challenge; recent national data indicate that about 1 in 9 adults aged 60 or older required substance use treatment, and ~1 in 12 met criteria for a substance use disorder in the past year.[1] Pain interference and financial insecurity are risk factors for substance use.[2] Pain interference refers to the degree to which pain reduces functioning and daily activities.[3] Individuals experiencing pain interference demonstrate elevated rates of non-medical prescription drug use and illicit substance use, with pain severity and functional impairment predicting increased substance use risk.[4] Financial insecurity similarly increases vulnerability to substance use initiation and progression to problematic use.[5] It simultaneously creates barriers to accessing substance use disorder treatment, with financial obstacles ranking among the most frequently cited reasons for not seeking care.[6]

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Although pain interference and financial insecurity are risk factors for substance use, relatively little is known about potential protective factors that may moderate their associations with substance use. Possible protective factors include religious service attendance, spirituality, and social connectedness. Religious service attendance may provide institutional support, accountability structures, and behavioral change opportunities that reduce substance use risk.[7] Spirituality may reduce stress and facilitate emotional healing.[8] According to the International Society of Addiction Medicine, spirituality can serve as "recovery capital" for individuals with substance use disorders.[9] Social connectedness, encompassing relationships, community ties, interpersonal networks, neighborhood trust, and feelings of belonging,[10] may buffer the impact of pain interference and financial stress on substance use through improved social support and reduced isolation.[11] There is a gap in understanding how these protective and risk factors (pain interference and financial insecurity) intersect in the context of substance use.

Protective factors like religious service attendance, spirituality, and social connectedness may differ across subpopulations. Understanding such variability may be important for developing culturally responsive interventions, especially given documented disparities among Black Americans in accessing substance use disorder treatment and pain management.[12] In addition, examining these relationships among individuals in midlife or older (aged 40 and above) is particularly important, as they experience peak rates of chronic pain conditions.[13] Persons in these age groups simultaneously confront increased financial pressures from health care costs, caregiving responsibilities, and retirement planning.[14] Concurrently, midlife and older adulthood represent critical periods when spiritual and religious practices often deepen,[15] potentially offering enhanced protective resources against substance use.

The current study of persons at midlife therefore used a dual-sample approach involving the US general population and Black Americans in Milwaukee, Wisconsin, to examine whether possible protective factors—religious service attendance, spirituality, and social connectedness—moderate the associations between risk factors (pain interference and financial insecurity) and substance use (Fig. 1). Milwaukee is one of the most racially segregated metropolitan areas in the United States,[16] with a significant Black population (39.8%) and high poverty rates (25%).[17] This context of concentrated urban disadvantage and systemic inequities provides an important setting for examining whether protective factors operate similarly or differently compared with a national sample. We hypothesized that: (1) pain interference and financial insecurity would be positively associated with substance use; (2) religious service attendance, spirituality, and social connectedness would moderate these risk factor associations; and (3) the moderating effects would vary between the 2 samples, with spirituality and religious service attendance showing stronger protective moderating association among Black Americans in Milwaukee compared with the general population.

MATERIALS AND METHODS

Participants

Participants included 2 Midlife in the United States (MIDUS) samples: a nationally representative US sample from MIDUS 3 (2013–2016) and MIDUS Refresher (2011–2014) waves (n = 4962), and an oversample of Black Americans from Milwaukee, WI, from both waves (n = 866). The national sample was recruited through random-digit dialing to represent non-institutionalized, English-speaking adults. MIDUS 3 followed MIDUS 1 (1995–1996), whereas the MIDUS Refresher recruited a new sample (2011–2014) to replenish the cohort. Data collection involved 30-minute telephone interviews and mailed questionnaires.

The Milwaukee Black American sample used stratified area probability sampling, focusing on census tracts with at least 40% Black American residents. This design aimed to increase the Black American sample size and improve representativeness. Half the tracts had median incomes below $40,000, and half at or above, to reflect socioeconomic diversity. Field interviewers conducted in-person screening to identify eligible Black American adults. Data collection involved 2.5-hour computer-assisted interviews at participants' homes, followed by mailed questionnaires. All participants gave informed consent. Data and detailed methodology documentation are available through the Inter-university Consortium for Political and Social Research (ICPSR).[18–20] The Yale Institutional Review Board approved this secondary data analysis (IRB Protocol ID: 2000037101).

Measures

The measures used in this study included risk factors, moderators, outcomes, and covariates (see below). Reverse coding was applied to specific items so that higher scores on all study measures indicate higher levels of the underlying construct.

Risk Factors: Pain Interference and Financial Insecurity

Pain interference was measured using 5 items from the Brief Pain Inventory Short Form (BPI),[21] summed to create a composite score (0–50) with excellent reliability ($\alpha = 0.95$ national sample, $\alpha = 0.92$ Milwaukee sample). Sensitivity analyses used a binary chronic pain measure based on respondents' self-reports of persistent pain lasting months to years. Financial insecurity was assessed through 20 yes/no items capturing adverse financial experiences (eg, job loss, missed mortgage/rent payments, missed credit card payments) summed to create a composite score (0–20)[22] with adequate reliability ($\alpha = 0.76$ national, $\alpha = 0.78$ Milwaukee samples).

Moderators: Religious Service Attendance, Spirituality, and Social Connectedness

Religious service attendance was measured by asking respondents, "How often do you attend religious or spiritual services?" Infrequent attendance (never or less

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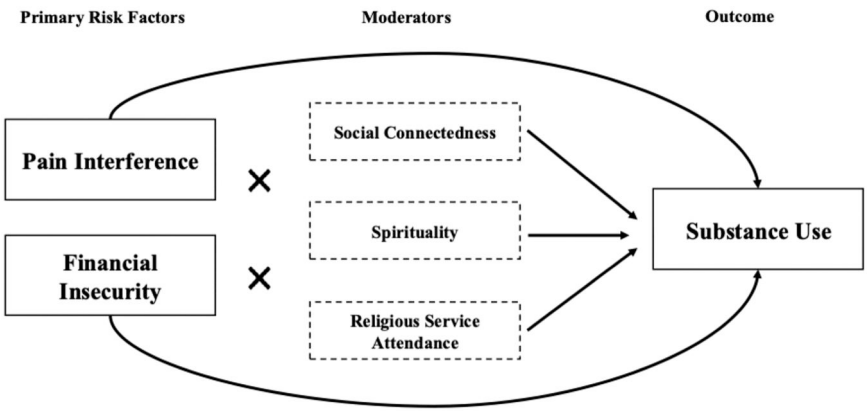


FIGURE 1. Concept diagram of risk factors, moderators, and substance use.

than once a month) was coded as 1; weekly attendance was coded as 2; and frequent attendance (a few times a week) was coded as 3.[23] Spirituality was assessed as a standardized composite score using a 5-item (0–4 point) scale measuring spiritual beliefs and experiences[24] ($\alpha = 0.89$ national sample, $\alpha = 0.90$ Milwaukee sample). Social connectedness was assessed using a standardized composite score derived from the 20 items across 6 dimensions: neighborhood social cohesion, social integration, support from family, support from friends, social contribution, and community contribution ($\alpha = 0.83$ national sample, $\alpha = 0.84$ Milwaukee sample). We constructed composite scores using structural equation modeling (SEM) with maximum likelihood estimation for missing values (MLMV) (Supplementary Table S1, Supplemental Digital Content 1, http://links.lww.com/JAM/A829).[25]

Outcome—Substance Use Score

The substance use measure yielded a score from 0 to 10 by totaling the number of 10 types of substances participants reported using without medical supervision or prescription during the past 12 months, including "painkillers," "sedatives," "tranquilizers," "stimulants," "depression medications," "inhalants," "cannabis/hashish," "cocaine/crack," "LSD/other hallucinogens," and "heroin." This approach has been used in other studies.[26] The measure captures non-medical substance use regardless of current legal status, with the focus on non-prescribed use patterns. Although cannabis's legal status was changing during the data collection period (2011–2014), our measure specifically assesses use without prescription or medical supervision rather than distinguishing legal from illegal substances.

Covariates

We selected covariates based on previous research.[27] Demographic covariates included age (centered around the mean), sex (male, female), and education level (less than high school, completed high school, some college, or college graduate). Economic and social stability indicators included employment status (full-time working, retired, unemployed, or other), marital status (married, previously married, or never married), annual household income (continuous measure, in $1000 increments), years at the current residence, and homeownership status (binary). Health status covariates included self-rated physical health (poor/fair, good, very good/excellent) and psychological distress using the Kessler-6 scale[28] sum score ($\alpha = 0.86$ national sample, $\alpha = 0.86$ Milwaukee sample).

Statistical Analyses

Data analyses proceeded in multiple steps. The MIDUS 3 and Refresher waves were pooled into cross-sectional data sets for both the national and Milwaukee samples. Descriptive analyses were conducted on all variables. Variance inflation factors (VIFs) were calculated to check for multicollinearity.[29] For all measures, we verified the distributions of the latent variables. To facilitate the interpretation and comparison of effect sizes across variables with different scales, all continuous variables were standardized (mean = 0, SD = 1) within each sample before multiple linear regression analyses. Categorical variables (sex, marital status, work status, self-rated physical health, education, and homeownership) retained their original coding. A 4-step sequential multiple linear regression modeling approach was used to incrementally build model complexity by: (1) establishing baseline associations, (2) systematically testing specific moderation hypotheses, and (3) evaluating the robustness of the findings from the previous models while accounting for potential overlap relationships between the risk factors and moderators (Fig. 1).

Model 1 was the baseline model and examined the associations between risk factors (pain interference and financial insecurity) and moderators (religious service attendance, spirituality, and social connectedness) with substance use, controlling for relevant covariates. Model 2 built upon the baseline model by adding interaction terms between pain interference and each protective factor (religious service attendance, spirituality, and social connectedness) to test whether these factors moderated

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the association between pain interference and substance use. Model 3 focused on financial insecurity and included interaction terms between financial insecurity and the 3 protective factors to test whether they moderated the association between financial insecurity and substance use. Model 4 includes both main effects and interaction terms. Our primary focus for hypothesis testing was on the interaction terms, which directly test whether protective factors moderate the risk factor-substance use associations. Model 4 is the primary model of interest.

We analyzed interaction terms regardless of the statistical significance of the main associations, as interactions can represent conditional or context-specific effects that are independent of the main relationships.[30] These 4 models were examined separately for the national and Milwaukee samples. For each linear regression model with both samples, we calculated standardized regression coefficients (β) along with their 95% CIs. To evaluate model fit and improvements across successive models within each sample, we assessed changes in R^2 values and conducted F tests comparing nested models. To assess the robustness of findings to the skewed, count nature of the substance misuse outcome, we conducted sensitivity analyses using negative binomial regression. All analyses were performed using STATA software (College Station, TX), with statistical significance set at $P < 0.05$ (2-tailed).

RESULTS

The national sample (N = 4962) included participants with a mean age of 58.1 years (SD = 14.0, range = 28–96); 54.2% were female. Most participants were married (66.4%), employed full-time (56.0%), had a college education (45.7%), were homeowners (84.2%), with a mean annual income of $23,100. Notably, 22.2% were retired. Compared with the national sample, the Milwaukee Black American sample (N = 866) was younger (mean age 50.7 y), more predominantly female (61.4%), less educated (14.6% college graduates), less likely to own homes (33.0%), with fewer retirees (11.7%), despite reporting higher mean household income ($42,200). The Milwaukee sample also reported notably higher financial insecurity (mean = 4.7 vs. 2.6), suggesting greater economic hardship despite higher reported income (Table 1). The Milwaukee sample also reported significantly higher financial insecurity (eg, job loss, housing instability, debt) (mean = 4.7 vs. 2.6) despite higher reported income. Most of the participants reported no substance use in the past 12 months (85.8% of the national sample; 79.7% of the Milwaukee sample). Among those reporting any use, most used only one substance type (74.7% in the national sample, 76.7% in Milwaukee), with few participants reporting polysubstance use of 3 or more types (9.3% national, 8.5% Milwaukee) (Table 1).

TABLE 1. Sociodemographic Characteristics of the Midlife in the US (MIDUS) participants

Variable	National Sample (N = 4962)	Milwaukee Sample (N = 866)
Mean age (SD)	58.1 (14.0)	50.7 (14.0)
Sex, n (%)		
Male	2272 (45.8)	334 (38.6)
Female	2690 (54.2)	532 (61.4)
Marital status, n (%)		
Married	3293 (66.4)	198 (22.9)
Previously married	1152 (23.2)	291 (33.6)
Never married	517 (10.4)	377 (43.5)
Education, n (%)		
Below high school	214 (4.3)	155 (17.9)
Completed high school	1028 (20.8)	247 (28.5)
Some college	1447 (29.2)	338 (39.0)
College or above	2263 (45.7)	126 (14.6)
Working status, n (%)		
Full-time employed	2778 (56.0)	408 (47.1)
Retired	1099 (22.2)	101 (11.7)
Unemployed or other	1085 (21.9)	357 (41.2)
Race		
Black American	260 (5.2)	866 (100)
White American	4284 (86.3)	
Others	418 (8.4)	
Year(s) living in the current neighborhood (mean, SD)	18.1 (14.9)	9.3 (10.2)
Homeownership, n (%)	4177 (84.2)	286 (33.0)
Mean annual income (per 1000 dollars, SD)	23.1 (42.4)	42.2 (46.7)
Self-rated physical health, n (%)		
Poor/fair	799 (16.1)	327 (37.8)
Good	1435 (28.9)	278 (32.1)
Very good/excellent	2728 (55.0)	261 (30.1)
Mean Kessler-6 sum score (SD) (possible range: 0–24)	2.9 (3.6)	5.3 (5.1)
Mean financial insecurity score (SD) (possible range: 0–20)	2.6 (2.7)	4.7 (3.4)
Mean pain interference (SD) (possible range: 0–50)	5.1 (11.3)	8.7 (15.6)
Substance use outcomes		
Mean substance use score (SD) (possible range: 0–10)	0.23 (0.72)	0.31 (0.80
No. substance types used in past 12 mo, n (%)		
0	4255 (85.8)	690 (79.7)
1	528 (10.6)	135 (15.6)
2	113 (2.3)	26 (3.0)
More than 3	66 (1.3)	15 (1.7)
Mean social connectedness crude score (SD)		
Neighborhood social cohesion (possible range: 0–24)	4.7 (1.4)	16.6 (4.7)
Social integration (possible range: 0–18)	11.8 (4.0)	10.3 (3.8)
Support from family (possible range: 0–12)	7.2 (2.0)	9.1 (3.0)
Support from friends (possible range: 0–12)	6.8 (2.0)	8.7 (3.0)
Contribution to community (possible range: 0–18)	10.9 (3.9)	13.2 (3.4)
Social contribution (possible range: 0–18)	9.5 (2.0)	12.0 (3.8)
Spirituality (possible range: 0–15)	16.8 (5.1)	11.5 (3.4)
Religious service attendance (possible range: 1–3)	1.6 (0.7)	1.8 (0.9)

Pain Interference, Financial Insecurity, and Moderators Across Samples

Table 2 presents the findings of the full model (ie, model 4) examining associations between pain interference, financial insecurity, and their interactions with moderator/potential protective factors (ie, religious service attendance, spirituality, and social connectedness) across both the national sample and Milwaukee Black American sample (see Supplementary Tables S2 & 3 for complete results, Supplemental Digital Content 1, http://links.lww.com/JAM/A829).

In the national sample, financial insecurity significantly predicted substance use (β = 0.06, 95% CI = 0.03, 0.09, $P < 0.001$). Religious service attendance showed a significant main effect (β = −0.07, 95% CI = −0.10, −0.04, $P < 0.001$) and significantly moderated the pain interference-substance use association (β = −0.03,

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95% CI = −0.06, −0.002, $P < 0.05$). This moderation indicates that the association between pain interference and substance use was weaker at higher levels of religious service attendance. Neither spirituality nor social connectedness moderated pain interference associations with substance use. None of the protective factors significantly moderated the financial insecurity-substance use association.

In the Milwaukee Black American sample, financial insecurity was the only significant main effect predictor ($\beta = 0.15$, 95% CI = 0.08, 0.22, $P < 0.001$). The associations between pain interference and substance use were moderated by both spirituality and social connectedness. Specifically, spirituality significantly moderated this association ($\beta = -0.12$, 95% CI = −0.18, −0.05, $P < 0.01$), indicating that the association between pain interference and substance use was weaker at higher levels of spirituality. In contrast, social connectedness moderated this association in the opposite direction ($\beta = 0.09$, 95% CI = 0.03, 0.16, $P < 0.01$), such that the association between pain interference and substance use was stronger at higher levels of social connectedness.

Sensitivity analyses using binary chronic pain coding (yes/no) instead of continuous pain interference scores were conducted to assess the robustness of our findings across different pain operationalizations (Table 2). These analyses yielded consistent patterns of findings in both the national and Milwaukee samples, supporting the stability of our results. In addition, sensitivity analyses using negative binomial regression yielded consistent patterns of findings across both samples (Supplementary Table S4, Supplemental Digital Content 1, http://links.lww.com/JAM/A829). The sequential modeling approach (Models 1–4, detailed in Supplementary Tables S5 & S6, Supplemental Digital Content 1, http://links.lww.com/JAM/A829) revealed that the distinct patterns between the 2 populations remained stable across all model iterations, with financial insecurity consistently emerging as a significant direct predictor in both samples, whereas pain interference-moderator interactions showed population-specific patterns.

DISCUSSION

This is one of the first studies to use a national sample and a regional sample of Black Americans from Milwaukee, WI, to examine whether religious service attendance, spirituality, and social connectedness moderate the associations between pain interference, financial insecurity, and substance use. Our findings revealed markedly different patterns of associations between the national and Milwaukee Black American samples, highlighting the possible importance of population-specific approaches to understanding substance use risk. Our hypotheses were partially supported: although pain interference and financial insecurity consistently predicted substance use, protective factors showed mixed effects, with religious service attendance and spirituality moderating associations but social connectedness unexpectedly amplified risk in the Milwaukee sample. The moderating effects varied between samples, although not all in the expected direction, with spirituality being more protective among Black Americans and religious service attendance being more protective in the national sample.

Our findings extend previous epidemiological research on substance use by demonstrating that religious service attendance seems to function not only as a direct predictor of lower substance use but also as a negative moderator that mitigates the relationship between pain interference and substance use.[31] Religious service attendance may promote social support, engagement in meaningful activities, norms that discourage substance use, and coping strategies such as prayer,[32] thereby offering a spiritual reframing of suffering that reduces reliance on substances for relief.

In the Milwaukee sample, we found significant moderation associations emerged through spirituality and social connectedness, suggesting that pain-related relationships with substance use may operate differently in this population. This pattern partially supports our hypothesis about the protective role of spirituality, but religious service attendance was not similarly protective in this sample. The protective role of spirituality, rather than organized religious service attendance, may reflect a shift toward more personal and adaptable forms of spiritual coping that can be maintained independently of formal religious institutions.[33] This possible reliance on spiritual coping instead of religious service attendance might coincide with the large number of church closures in Black communities in the United States.[34]

Contrary to our expectations, social connectedness did not emerge as an independent predictor of substance use. Moreover, social connectedness demonstrated a significant positive moderating effect on the relationships between pain interference and substance use in the Milwaukee Black American sample, contradicting our hypothesis that it would serve as a protective moderator. This finding may reflect differences in norms surrounding substance use, especially in networks experiencing systemic inequities.[35] Although our study did not include direct measures of systemic inequities, the samples differed considerably on proxies for systemic inequities such as educational attainment and homeownership, which may help explain these divergent patterns. In addition, our study used a cross-sectional design, so the directionality of observed associations remains unclear.

A consistent finding across both samples was that financial insecurity operated as an independent risk factor for substance use, aligning with our hypothesis, with its associations unmoderated by any of the possible protective factors (religious service attendance, spirituality, or social connectedness). This pattern may reflect what Mulia and colleagues observed: financial stressors accompanied by systemic inequities can overwhelm the potential protective effects that social and spiritual resources typically provide.[36] Moreover, financial insecurity reduces access to health care and formal support services.[37] Notably, the strength of this association was

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TABLE 2. Associations Between Pain Interference, Financial Insecurity, Religious Service Attendance, Spirituality, Social Connectedness, and Substance Use: Analysis From the MIDUS 3 and Refreshers National Data sets

	National Sample (N = 4962)		Milwaukee Black Sample (N = 866)	
	Pain Interference	Chronic Pain	Pain Interference	Chronic Pain
Variable	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
Main associations				
Pain	**0.11 (0.08, 0.14)***	**0.12 (0.06, 0.18)****	0.03 (−0.05, 0.11)	0.08 (−0.07, 0.23)
Financial insecurity	**0.06 (0.03, 0.09)***	**0.06 (0.03, 0.09)****	**0.15 (0.08, 0.22)***	**0.15 (0.08, 0.22)***
RELI	**−0.07 (−0.10, −0.04)***	**−0.05 (−0.09, −0.02)****	0.03 (−0.04, 0.09)	0.02 (−0.06, 0.10)
SPIRIT	0.03 (−0.004, 0.06)	0.03 (−0.01, 0.07)	−0.03 (−0.10, 0.04)	0.04 (−0.05, 0.13)
SC	−0.01 (-0.04, 0.03)	-0.01 (-0.05, 0.03)	-0.02 (-0.09, 0.06)	0.02 (-0.06, 0.10)
Interactions				
Pain × RELI	**-0.03 (-0.06, -0.002)*****	-0.06 (-0.12, 0.002)	-0.005 (-0.07, 0.06)	0.03 (-0.11, 0.17)
Pain × SPIRIT	0.0003 (-0.03, 0.03)	−0.01 (−0.07, 0.06)	**−0.12 (−0.18, −0.05)****	**-0.27 (-0.42, -0.11)****
Pain × SC	0.01 (−0.02, 0.03)	0.01 (−0.06, 0.07)	**0.09 (0.03, 0.16)****	**0.21 (0.06, 0.36)****
Financial insecurity ∗ RELI	−0.03 (−0.05, 0.002)	−0.03 (−0.05, 0.001)	−0.004 (−0.07, 0.06)	−0.01 (−0.07, 0.06)
Financial insecurity ∗ SPIRIT	−0.004 (-0.03, 0.03)	−0.004 (-0.03, 0.03)	−0.02 (−0.09, 0.05)	−0.03 (−0.10, 0.05)
Financial insecurity ∗ SC	−0.02 (−0.04, 0.01)	−0.02 (−0.04, 0.01)	−0.06 (−0.13, 0.02)	−0.05 (−0.12, 0.02)
R^2	0.089	0.083	0.116	0.116

All models were adjusted for sex, marital status, working status, years living in the current neighborhood, self-rated physical health, psychological distress, education, age, and homeownership.

RELI indicates religious service attendance; SC, social connectedness; SPIRIT, spirituality.

*Significance level: $P < 0.001$.

**$P < 0.01$.

***$P < 0.05$.

particularly pronounced in the Milwaukee sample (β = 0.15) compared with the national sample (β = 0.06), potentially reflecting the compounded effects of systemic inequities and concentrated economic disadvantage in urban Black communities. These findings suggest that addressing substance use in economically disadvantaged populations may need structural interventions targeting economic factors, not just individual efforts.

Limitations

First, the binary chronic pain variable in the MIDUS data set asked participants: "Do you have chronic pain that persists beyond the time of normal healing and has lasted from anywhere from a few months to many years?" This wording differs from definitions typically used by pain researchers (eg, persistent or recurrent pain lasting longer than 3 mo).[38] This may limit direct comparisons with studies that utilize duration-based definitions of chronic pain. However, this study focused on pain interference, which is a well-established and valid measure of pain experience that captures the functional impact of pain on daily activities and quality of life.[21] Second, we examined social connectedness as a composite variable. We chose this approach because we lacked sufficient statistical power to conduct multiple regression analyses for each component. However, this approach may have obscured nuanced patterns between specific dimensions of social connectedness and substance use outcomes.

Third, the 2 study samples differed significantly on sociodemographic characteristics, including age, education, employment, homeownership, income, and financial insecurity. The Milwaukee sample reported a higher mean income, despite lower education and homeownership, likely due to older age and more retirees in the national sample. The Milwaukee participants experienced higher financial insecurity (4.7 vs. 2.6), suggesting that financial insecurity may be a better indicator of economic hardship than income. Beyond demographic differences, the Milwaukee sample had substantial missingness in social connectedness and spirituality measures compared with the national sample. Although we used MLMV to address it, we cannot rule out the possibility of non-random missingness that could bias our estimates. Although we controlled for observed demographic differences, the distinct sampling frames and differential missingness patterns limit direct comparisons of effect sizes between samples.

In addition, the Milwaukee sample represents a single urban community and may not generalize to Black Americans in other geographic contexts. More broadly, the survey designs from pooled national data, and the Milwaukee data had no probability weights. Therefore, the results from both data are not generalizable to the populations from which these samples were drawn.

Fourth, the substance use measure combined ten substance types into a composite score to capture the breadth of polysubstance use involvement. Although this broad approach aligns with the study's goal of examining general substance use protective mechanisms, the composite measure does not distinguish among specific substance types (eg, opioids vs. cannabis), use severity, or frequency. In addition, cannabis's changing legal status during 2011–2014 raises questions about comparability, but sensitivity analyses excluding cannabis showed consistent results (Supplementary Table S7 & S8, Supplemental Digital Content 1, http://links.lww.com/JAM/A829), indicating robustness.

Notably, the substance use outcome showed a highly skewed distribution, with 85.8% (national sample)

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and 79.7% (Milwaukee sample) reporting no substance use in the past 12 months. Despite this skewness, we used untransformed multivariable linear regression, supported by multiple lines of evidence. Ladder of powers analyses indicated that no transformation improved distributional properties in either sample, and generalized linear models with the Gaussian family and identity link yielded results identical to ordinary least squares regression (Supplementary Table S9, Supplemental Digital Content 1, http://links.lww.com/JAM/A829). In addition, our large sample sizes (N = 4962 and N = 866) provide robustness to distributional violations through the Central Limit Theorem,[39] and standardization of all continuous variables reduced the influence of extreme values.

Although we modeled pain interference and financial insecurity as predictors of substance use, these relationships are likely bidirectional. For example, the observed associations with protective factors could reflect substance use reducing religious attendance or social connectedness, rather than these factors preventing substance use. All findings should be interpreted as associations rather than causal relationships. Finally, residual confounding remains and the possibility that unmeasured variables could explain the association between mediators and substance use.

Conclusions and Implications

Our study supports testing religious and spiritual interventions (eg, SAMHSA's Faith-Based Toolkit for diverse populations with pain interference and substance use).[40] Future longitudinal research should establish temporal relationships and examine mediating mechanisms, such as whether access to evidence-based pain management treatments mediates the pathway from pain interference to substance use. Such analyses would complement our moderation findings by identifying both for whom (moderation by protective factors) and through what mechanisms (mediation by treatment access) pain interference relates to substance use, with implications for integrating pain management into substance use prevention programs.

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REFERENCES

1. Center for Behavioral Health Statistics and Quality. Behavioral Health among Older Adults: Results from the 2021 and 2022 National Surveys on Drug Use and Health. Substance Abuse and Mental Health Services Administration. Accessed 20 January 2026. https://www.samhsa.gov/data/report/older-adult-behavioral-health-report-2021-2022
2. McDermott KA, Joyner KJ, Hakes JK, et al. Pain interference and alcohol, nicotine, and cannabis use disorder in a national sample of substance users. *Drug Alcohol Depend*. 2018;186:53–59.
3. Cleeland CS, Ryan KM. Pain assessment: global use of the Brief Pain Inventory. *Ann Acad Med Singapore*. 1994;23(2):129–138.
4. Schaffer J, Fogelman N, Seo D, et al. Chronic pain, chronic stress and substance use: overlapping mechanisms and implications. *Front Pain Res*. 2023;4:1145934.
5. Wyse JJ, Lovejoy J, Holloway J, et al. Patients' perceptions of the pathways linking chronic pain with problematic substance use. *Pain*. 2021;162(3):787–793.
6. Ali MM, Teich JL, Mutter R. Reasons for not seeking substance use disorder treatment: variations by health insurance coverage. *J Behav Health Serv Res*. 2017;44(1):63–74.
7. DeHaven MJ, Hunter IB, Wilder L, et al. Health programs in faith-based organizations: are they effective? *Am J Public Health*. 2004;94(6):1030–1036.
8. Kelly JF. Is Alcoholics Anonymous religious, spiritual, neither? Findings from 25 years of mechanisms of behavior change research. *Addiction*. 2017;112(6):929–936.
9. Galanter M, Hansen H, Potenza MN. Article commentary: the role of spirituality in addiction medicine: a position statement from the spirituality interest group of the international society of addiction medicine. *Subst Abus*. 2021;42(3):269–271.
10. Holt-Lunstad J. Social connection as a public health issue: the evidence and a systemic framework for prioritizing the "Social" in social determinants of health. *Annu Rev Public Health*. 2022;43(2022):193–213.
11. Lookatch SJ, Wimberly AS, McKay JR. Effects of social support and 12-step involvement on recovery among people in continuing care for cocaine dependence. *Substance Use Misuse*. 2019;54(13):2144–2155.
12. Farahmand P, Arshed A, Bradley MV. Systemic racism and substance use disorders. *Psychiatr Ann*. 2020;50(11):494–498.
13. Domenichiello AF, Ramsden CE. The silent epidemic of chronic pain in older adults. *Prog Neuro-Psychopharmacol Biol Psychiatry*. 2019;93:284–290.
14. Infurna FJ, Gerstorf D, Lachman ME. Midlife in the 2020s: opportunities and challenges. *Am Psychol*. 2020;75(4):470.
15. Grim BJ, Grim ME. Belief, behavior, and belonging: how faith is indispensable in preventing and recovering from substance abuse. *J Relig Health*. 2019;58(5):1713–1750.
16. Cheng M. Milwaukee's still super segregated, but a few neighborhoods have become more diverse. Accessed January 23, 2025. https://www.wuwm.com/2022-04-05/milwaukees-still-super-segregated-but-a-few-neighborhoods-have-become-more-diverse
17. United States Census Bureau. Quick facts: Milwaukee City, Wisconsin. Accessed January 24, 2025. https://www.census.gov/quickfacts/fact/table/milwaukeecitywisconsin,WI/PST045221
18. Institute on Aging, University of Wisconsin-Madison. MIDUS Geo-coding README. Linking External Contextual Variables to MIDUS Datasets at Different Geographic Levels. Accessed January 10, 2025. http://midus.wisc.edu/data/MIDUS_Geo-coding_README_20220329.pdf
19. Radler BT, Ryff CD. Who participates? Accounting for longitudinal retention in the MIDUS national study of health and well-being. *J Aging Health*. 2010;22(3):307–331.
20. Radler BT. The Midlife in the United States (MIDUS) series: a national longitudinal study of health and well-being. *Open Health Data*. 2014;2(1):e3.
21. Cleeland CS, Ryan K. The brief pain inventory. *Pain Res Group*. 1991;20(20):143–147.
22. Forbes MK, Krueger RF. The great recession and mental health in the United States. *Clin Psychol Sci*. 2019;7(5):900–913.
23. Chen Y, VanderWeele TJ. Associations of religious upbringing with subsequent health and well-being from adolescence to young adulthood: an outcome-wide analysis. *Am J Epidemiol*. 2018;187(11):2355–2364.
24. Underwood LG, Teresi JA. The daily spiritual experience scale: development, theoretical description, reliability, exploratory factor analysis, and preliminary construct validity using health-related data. *Ann Behav Med*. 2002;24(1):22–33.
25. Maydeu-Olivares A. Maximum likelihood estimation of structural equation models for continuous data: standard errors and goodness of fit. *Struct Eq Model Multidiscipl J*. 2017;24(3):383–394.
26. Steinhoff A, Bechtiger L, Ribeaud D, et al. Polysubstance use in early adulthood: Patterns and developmental precursors in an urban cohort. *Front Behav Neurosci*. 2022;15:797473.
27. McGovern MP, Dunn J, Bonnell LN, et al. The association between depression and substance use among primary care patients with comorbid medical and behavioral health conditions. *J Prim Care Commun Health*. 2023;14:21501319231200302.

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28. Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med*. 2002;32(6):959–976.
29. Kim JH. Multicollinearity and misleading statistical results. *Korean J Anesthesiol*. 2019;72(6):558–569.
30. Corraini P, Olsen M, Pedersen L, et al. Effect modification, interaction and mediation: an overview of theoretical insights for clinical investigators. *Clin Epidemiol*. 2017:331–338.
31. Livne O, Wengrower T, Feingold D, et al. Religiosity and substance use in US adults: findings from a large-scale national survey. *Drug Alcohol Depend*. 2021;225:108796.
32. Barry DT, Savant JD, Beitel M, et al. Use of conventional, complementary, and alternative treatments for pain among individuals seeking primary care treatment with buprenorphine-naloxone. *J Addict Med*. 2012;6(4):274–279.
33. Ammerman NT. Spiritual but not religious? Beyond binary choices in the study of religion. *J Sci Study Relig*. 2013;52(2):258–278.
34. Ransome Y, Song I, Busette C. Churches are closing in predominantly Black communities – why public health officials should be concerned. Brookings. Accessed July 15, 2025. https://www.brookings.edu/articles/churches-are-closing-in-predominantly-black-communities-why-public-health-officials-should-be-concerned/
35. Lateef H, Azasu EK, Boahen-Boaten BB, et al. Afrocentric norms and substance use behaviors among Black young adults. *Soc Work Public Health*. 2024;39(7):678–690.
36. Mulia N, Schmidt L, Bond J, et al. Stress, social support and problem drinking among women in poverty. *Addiction*. 2008;103(8):1283–1293.
37. Saylor MA, Clair C, Bandaru V, et al. A meta-synthesis of the cycle of financial strain, coping behaviors and health outcomes across the life course. *Soc Sci Hum Open*. 2024;10:101106.
38. Treede R-D, Rief W, Barke A, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). *Pain*. 2019;160(1):19–27.
39. Lumley T, Diehr P, Emerson S, et al. The importance of the normality assumption in large public health data sets. *Annu Rev Public Health*. 2002;23(1):151–169.
40. Substance Abuse and Mental Health Services Administration. SAMHSA's Faith-Based Toolkit. Accessed April 3, 2025. https://www.samhsa.gov/communities/faith-based-community-engagement

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