Sources of Stress among Adults with Co-occurring Drug Use and Depressive Symptoms

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Published online: 17 August 2018
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Abstract Stress, drug use, and depression are interconnected, but less is understood about sources of stress among adults with co-occurring drug use and depressive symptoms. The current study aimed to identify sources of stress and correlates among these adults. Data come from a cross-sectional baseline survey, including participants ($n = 336$) 18 to 55 years old, who reported past 6-month heroin or cocaine use and depressive symptoms. Exploratory factor analysis was conducted to identify sources of stress. Chi-square and multivariable Poisson regression with robust error variance were used to explore correlates of each factor. Three sources of stress were identified: financial stress related to drugs, stress due to community features, and stress involving a person's network. Past 6-month injection drug use ($aPR = 1.34$, 95% CI 1.07–1.67), perceived lack of control over drug use ($aPR = 1.80$, 95% CI 1.41–2.30), and difficulty abstaining from drug use ($aPR = 1.55$, 95% CI 1.22–1.97) were associated with an increased risk of high drug-related financial stress. Neighborhood disorder ($aPR = 2.42$, 95% CI 1.80–3.24) and sleeping on the street ($aPR = 1.37$, 95% CI 1.04–1.80) were associated with an increased risk of high community-level stress.

Past 6-month injection drug use ($aPR = 1.28$, 95% CI 1.04–1.58), perceived lack of control over drug use ($aPR = 1.37$, 95% CI 1.10–1.70), and drug use stigma was associated with an increased prevalence of high drug network stress ($aPR = 1.32$, 95% CI 1.05–1.65). Stress is a complex construct, including distinct sources and correlates. Further understanding of sources of stress is beneficial in recognizing potentially modifiable challenges faced by individuals who use drugs and experience depressive symptoms.

Keywords Stress · Drug use · Depression · Co-occurring disorders

Introduction

According to the 2016 National Survey on Drug Use and Health, 43.3% of individuals with a past year substance use disorder also had a mental health disorder. Among adults with any mental health disorder in the past year, 18.5% also had a substance use disorder [1]. These numbers represent 8.2 million adults, and 3.4% of

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all adults in the USA having a co-occurring mental health and substance use disorder [2]. These alarming statistics provide further evidence for the importance of considering factors related to both mental health conditions and substance use when identifying challenges faced by individuals.

Depression and drug use influence each other and share a number of risk factors [3, 4]. Theories of this bidirectional relationship include self-medicating, where individuals use substances to cope with depressive symptoms, or substance use increasing the likelihood of other risk factors (e.g., economic hardship) of depression [5–7]. Research also suggests that neurobiological pathways are associated with this comorbidity. These include alterations in neurotransmitter systems and in the frontal-limbic brain network [6]. Individuals with co-occurring substance use and depressive disorders are also more likely to be homeless, live in poverty, and experience incarceration [8, 9]. Therefore, individuals with co-occurring substance use and depressive disorders may have augmented challenges related to socioeconomic conditions and associated stress.

The association between stress, drug use, and depression is well established in the literature, but these interrelationships are not fully understood [10–17]. Stress is defined here, as in previous work by Sinha (2008), as “processes involving perception, appraisal, and response to harmful, threatening, or challenging events or stimuli” [18–20]. Stress can result in the initiation of drug use and increased likelihood of a substance use disorder [5, 10, 21]. Drug use has also been shown to lead to stress and can impact a person’s response to stress [15]. Extensive literature supports the association between stress and depression, in which both chronic and acute stressful experiences predict the onset of depressive symptoms and impact the duration, severity, and overall course of depression [22–25].

Despite understanding the link between stress, drug use, and depressive symptoms, less research exists on specific sources of stress among individuals who use drugs and experience depressive symptoms. Neighborhood disadvantage is one possible source of stress associated with drug use and depression. Boardman and colleagues (2001) found that neighborhood disadvantage (e.g., low income and/or high unemployment rate) was associated with increased stress and psychological distress, and decreased social resources. Further, the researchers found that individuals who reported any drug use within the past year had a significantly higher

mean neighborhood disadvantage score compared to those who did not report using drugs. As the authors explain, some of this impact could be due to an increase in social stressors [26]. Another possible source of stress examined in the literature is the stigma associated with drug use and depression. Stigma has been linked to chronic stress, such as discrimination experienced by individuals who use drugs [13, 27]. Moreover, both stigma and discrimination experienced by individuals who report using drugs is associated with mental health disorders, including depression, and other physical health outcomes [13, 27, 28]. In the current study, using exploratory factor analysis, we aimed to explore sources of stress that might be particularly relevant to the vulnerable population of people with co-occurring drug use and depressive symptoms, including individual, neighborhood, and social factors. We further investigated the associations between relevant correlates and different sources of stress.

Methods

Study Design and Sample

The current study is a cross-sectional study that took place in Baltimore City. It included individuals who participated in the baseline session of a randomized controlled trial aimed at reducing risky drug and sexual behaviors through the development of skills to manage depressive symptoms and stress [29]. Individuals were recruited using convenience sampling methods, including street-based outreach, flyers, newspaper advertisements, and word-of-mouth. Those eligible after initial screening were paid 35 dollars upon completion of a baseline survey, that consisted of self-report measures and an audio computer assisted self-interview. Inclusion criteria for the cross-sectional study included the following: (1) 18–55 years old, (2a) injected drugs more than three times in past week, or (2b) snorted/sniffed heroin or snorted/smoked cocaine in the past 6 months and reported at least one risky sexual behavior (e.g., two or more sex partners, sex partner who injected drugs, sex partner who was HIV positive) in the past 6 months, and (3) had a Center for Epidemiologic Studies Depression Scale (CES-D) score of 16 or greater. The CES-D is a 20-item, 4-point scale shown to be a valid and reliable measure for assessing symptoms of depression in the general population. The cutoff score of 16 or greater has

been used to indicate probable clinical depression [30–32]. The study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Measures

Outcome Variables

Sources of Stress Individuals were asked questions about the following 10 sources of stress: lack of money, current housing situation, relationship with family members, neighborhood you live in, drug use, getting money to buy drugs, purchasing drugs, using drugs with other people, and arguing with your family about your drug use. For each, participants reported if the item was “not stressful,” “somewhat stressful,” or “very stressful.” An additional item asked about stress due to a relationship with a main sexual partner, but was excluded because of the 130 (38.7%) missing cases due to not reporting having a main sexual partner on an earlier survey question. The internal consistency for the 10 items was acceptable ($\alpha = 0.71$) [33, 34]. Pilot testing with the target population confirmed adequate face validity.

Potential Correlates

Demographic Characteristics Individuals reported sex, education level (dichotomized as “completed less than high school” or “more than high school”), race (dichotomized as “Black or African American” or “Other”), current employment status (categorized as “unemployed,” “employed,” or “disabled”), and current age. Based on the skewed distribution, age was dichotomized at the median (44 years old).

Individual Characteristics and Behaviors Participants were asked to report any injection drug use (“yes” or “no”) in the past 6 months. HIV status (“positive” or “negative”) was collected based on self-report and an antibody test administered at baseline. Individuals also reported any sex exchanged for money, drugs, food, or shelter in the past 90 days (“yes” or “no”). Two items inquired about perceptions of problem drug use, including, “How often do you think that your drug use is out of control?” with the response options including (a) never, (b) sometimes, (c) often, (d) always, and (e) don’t know (dichotomized as “never or sometimes” or “often or always”), and “How difficult do you find it to stop or

go without using drugs?” and the response options were (a) not difficult, (b) somewhat difficult, (c) very difficult, (d) impossible, and (e) don’t know (dichotomized as “not difficult or somewhat difficult” or “very difficult or impossible”).

Drug Use Stigma Participants answered 27 questions that assessed drug use stigma. For example, “People avoid me because of my drug use” or “I feel ashamed for using drugs.” Responses options were (a) strongly disagree, (b) disagree, (c) neither disagree or agree, (d) agree, or (e) strongly agree.” Seven items were dropped based on low item-test correlation, leaving 20 questions that held together as a scale ($\alpha = 0.89$). Pilot tests indicated appropriate face validity. The final drug use stigma variable was dichotomized, as “other” (strongly disagree, disagree, and neither disagree or agree) or “strongly agree or agree” based on the original response options.

Housing Stability Individuals reported if they had slept on the street and/or stayed in a homeless shelter in the past 6 months (“yes” or “no”). They also reported the number of times they had moved residences in the past 6 months (categorized as zero, one, or two or more moves).

Neighborhood Disorder Neighborhood disorder consisted of seven items derived from Perkins and Taylor’s Block Environmental Inventory [24, 35]. Participants reported how problematic the following were in their neighborhood: vandalism, vacant housing, litter in streets, teenagers loitering, burglary, drug sales, and robbery. Participants responded with (a) not a problem, (b) somewhat of a problem, and (c) a big problem to each item. The neighborhood disorder scale demonstrated high internal consistency ($\alpha = 0.87$). Based on the item distribution, neighborhood disorder was dichotomized as “not a problem” or “somewhat or a big problem” for analyses.

Statistical Analyses

An exploratory factor analysis of the 10 sources of stress items was used to determine linear combinations of variables to assess if stress was one overarching concept or if it should be viewed as separate constructs [36]. Principal component analysis, scree plot, and parallel analysis were conducted to extract components and

determine the appropriate number of factors [36, 37]. The selection of the number of factors was based on eigenvalues above one and a parallel analysis. A factor analysis with a polychoric correlation was then specified because of the categorical nature of the indicator variables, and iterated principal factor (IPF) was used for model estimation [38]. To help with interpretation, promax rotation was used to account for correlation between the factors ($>.30$) [39]. Item loadings ($>.40$) and uniqueness ($<.60$) were assessed, with the aim of retaining at least three items per factor [39]. After determining the sources of stress factors, each was dichotomized at the median score to indicate high or low stress. To address our second aim of testing associations between correlates and each source of stress, chi-square tests were completed. Correlates that were statistically significant ($p < .05$) were included in multivariable Poisson regression models with robust error variance for each of the sources of stress factors to obtain adjusted prevalence ratios (aPR). Poisson regression models with robust error variance have been used with dichotomous outcomes and have been shown to produce results similar to the Mantel-Haenszel procedure [40]. All analyses were completed using Stata 14.2.

Results

Sample Characteristics

Sample characteristics are presented in Table 1. The sample included 336 adults, 59.2% of whom were male, 52.1% were 44 to 55 years old ($M = 43.1$, $SD = 7.4$), and 82.1% were Black or African American. Fifty-six percent had not completed high school and 59.2% were unemployed.

Factor Analysis

Based on the principal component analysis and parallel analysis, three sources of stress factors were derived, explaining 62% of the variance. Factor 1 (drug-related financial) consisted of the following variables: (1) lack of money, (2) drug use, (3) getting money to buy drugs, and (4) purchasing drugs. Factor 2 (community-level) comprised of (1) current housing situation, (2) relationship with family members, and (3) neighborhood. Factor 3 (drug network) included (1) using drugs with other people, (2) arguing with drug partners about drugs, and

Table 1 Demographic characteristics of adults with co-occurring drug use and depressive symptoms ($n = 336$)

	<i>n</i> (%)
Sex	
Female	137 (40.8)
Male	199 (59.2)
Race/ethnicity	
Black or African American	276 (82.1)
Other	60 (17.9)
Age	
19 to 43	161 (47.9)
44 to 55	175 (52.1)
Education level	
Less than 12th grade	187 (55.7)
Completed high school or above	149 (44.4)
Employment status	
Unemployed	199 (59.2)
Employed	23 (6.9)
Disabled	114 (33.9)
HIV status	
Negative	291 (86.6)
Positive	45 (13.4)
Sex exchange in past 90 days	
No	139 (43.9)
Yes	178 (56.2)
Injection drug use in past 6 months	
No	174 (51.8)
Yes	162 (48.2)
Drug use out of control	
Never or sometimes	179 (53.3)
Often or always	157 (46.7)
Difficult to stop using or go without drugs	
Never or sometimes	164 (48.8)
Often or always	172 (51.2)
Drug use stigma	
Agree or strongly agree	44 (13.1)
Other	292 (86.9)
Sleep on street in past 6 months	
No	231 (68.8)
Yes	105 (31.3)
Homeless shelter in past 6 months	
No	254 (75.6)
Yes	82 (24.4)
Frequency of moves in past 6 months	
0	171 (50.9)
1	49 (14.6)
2 or more	116 (34.5)

Table 1 (continued)

	<i>n</i> (%)
Neighborhood disorder	
Not a problem	192 (57.3)
Somewhat or a big problem	143 (42.7)
	Mean (SD)
CES-D score	29.09 (10.12)

(3) arguing with family about drug use (Table 2). The correlations between factors were the following: 0.43 for one and two, 0.43 for one and three, and 0.19 for two and three.

Univariate Associations between Correlates and Each Source of Stress

Injecting cocaine or heroin in the past 6 months, reporting drug use out of control, and finding it difficult to stop using drugs were significantly associated with drug-related financial stress (Table 3).

HIV status, reporting drug use out of control, and difficulty stopping the use of drugs were significantly associated with community-level stress. Housing instability (homelessness, sleeping in a shelter, and frequent moves) and neighborhood disorder were significantly associated with community-level stress (Table 3).

Injecting heroin or cocaine in the past 6 months, reporting drug use out of control, exchanging sex in the past 90 days, and drug use stigma were significantly associated with drug network stress (Table 3).

Multivariable Associations between Correlates and Each Source of Stress

Drug-Related Financial Stress Injecting heroin or cocaine in the past 6 months (aPR = 1.34, 95% CI 1.07–1.67), reporting drug use out of control (often or always) (aPR = 1.80, 95% CI 1.41–2.30), and reporting often or always finding it difficult to stop using drugs (aPR = 1.55, 95% CI 1.22–1.97) were associated with an increased prevalence of high drug-related financial stress (Table 4).

Community-Level Stress Reporting neighborhood disorder as a problem (somewhat or big) was associated with an increased prevalence of high community-level stress (aPR = 2.42, 95% CI 1.80–3.24). Sleeping outside in the past 6 months (aPR = 1.37, 95% CI 1.04–1.80) was significantly associated with an increased risk of high community-level stress (Table 4).

Drug Network Stress Injecting heroin or cocaine in the past 6 months (aPR = 1.28, 95% CI 1.04–1.58) and reporting drug use out of control (often or always) (aPR = 1.37, 95% CI 1.10–1.70) were significantly associated with higher prevalence of high drug network stress (Table 4). Experiencing drug use stigma was also associated with an increased risk of high drug network stress (aPR = 1.32, 95% CI 1.05–1.65). For this model, 317 participants were included. Nineteen of the 336 participants were excluded due to skip patterns in the survey causing the sex exchange question to be omitted.

Table 2 Exploratory factor analysis results: stress items, factor loadings, and corresponding factors

Item	F1	F2	F3	Factor
How stressful is the lack of money for you	<i>0.5087</i>	0.2622	–0.2477	Drug-related financial
How stressful is your drug use	<i>0.6171</i>	0.0489	0.0443	Drug-related financial
How stressful is getting money to buy drugs	<i>0.9282</i>	–0.0149	0.0211	Drug-related financial
How stressful is purchasing drugs	<i>0.4592</i>	–0.1206	0.2640	Drug-related financial
How stressful is your current housing situation	–0.0166	<i>0.6565</i>	0.0279	Community-level
How stressful is the neighborhood that you live in	–0.0827	<i>0.5640</i>	0.0268	Community-level
How stressful is your relationships with your family members	0.0652	<i>0.6568</i>	0.0820	Community-level
How stressful is using drugs with other people	0.0712	–0.1432	<i>0.6276</i>	Drug network
How stressful is arguing with your drug partners about drugs	–0.0301	0.0992	<i>0.8097</i>	Drug network
How stressful is arguing with your family about your drug use	0.0107	0.2547	<i>0.5072</i>	Drug network

Note: Italic values indicate loadings above 0.40

Table 3 Unadjusted associations with drug-related financial stress, community-level stress and drug network stress

	Drug-related financial			Community-level			Drug network		
	<i>n</i> (%)		<i>p</i> value	<i>n</i> (%)		<i>p</i> value	<i>n</i> (%)		<i>p</i> value
	High	Low		High	Low		High	Low	
Age									
19 to 43	83 (51.6)	78 (48.5)	.089	65 (40.4)	96 (59.6)	.886	78 (48.5)	83 (51.6)	.285
44 to 55	74 (42.3)	101 (57.7)		72 (41.1)	103 (58.9)		95 (54.3)	80 (45.7)	
Sex									
Male	89 (44.7)	110 (55.3)	.375	82 (41.2)	117 (58.8)	.846	105 (52.8)	94 (47.2)	.573
Female	68 (49.6)	69 (50.4)		55 (40.2)	82 (59.9)		68 (49.6)	69 (50.4)	
Race									
Black or African American	122 (44.2)	154 (55.8)	.047	106 (38.4)	170 (61.6)	.058	145 (52.5)	131 (47.5)	.410
Other	35 (58.3)	25 (41.7)		31 (51.7)	29 (48.3)		28 (46.7)	32 (53.3)	
Education level									
Less than high school	92 (49.2)	95 (50.8)	.309	78 (41.7)	109 (58.3)	.695	102 (54.6)	85 (45.5)	.209
High school or above	65 (43.6)	84 (56.4)		59 (39.6)	90 (60.4)		71 (47.7)	78 (52.4)	
Employment status									
Unemployed	100 (50.3)	99 (49.8)	.286	81 (40.7)	118 (59.3)	.286	100 (50.3)	99 (49.8)	.284
Employed	9 (39.1)	14 (60.9)		6 (26.1)	17 (73.9)		9 (39.1)	14 (60.9)	
Disabled	48 (42.1)	66 (57.9)		50 (43.9)	64 (56.1)		64 (56.1)	50 (43.9)	
Injected heroin or cocaine in past 6 months									
Yes	93 (57.4)	69 (42.6)	.000	72 (44.4)	90 (55.6)	.186	94 (58.0)	68 (42.0)	.021
No	64 (36.8)	110 (63.2)		65 (37.4)	109 (62.6)		79 (45.4)	95 (54.6)	
Drug use out of control									
Never or sometimes	56 (31.3)	123 (68.7)	.000	63 (35.2)	116 (64.8)	.026	76 (42.5)	103 (57.5)	.000
Often or always	101 (64.3)	56 (35.7)		74 (47.1)	83 (52.9)		97 (61.8)	60 (38.2)	
Find it difficult to stop using drug(s)									
Not or somewhat difficult	55 (33.5)	109 (66.5)	.000	56 (34.2)	108 (65.9)	.016	77 (47.0)	87 (53.1)	.104
Very difficult or impossible	102 (59.3)	70 (40.7)		81 (47.1)	91 (52.9)		96 (55.8)	76 (44.2)	
Sex exchange in past 90 days									
Yes	89 (50.0)	89 (50.0)	.181	79 (44.4)	99 (55.6)	.211	103 (57.9)	75 (42.1)	.019
No	59 (42.5)	80 (57.6)		52 (37.4)	87 (62.6)		62 (44.6)	77 (55.4)	

Table 3 (continued)

	Drug-related financial		<i>p</i> value	Community-level		<i>p</i> value	Drug network		<i>p</i> value
	<i>n</i> (%)			<i>n</i> (%)			<i>n</i> (%)		
	High	Low		High	Low		High	Low	
HIV status									
Positive	17 (37.8)	28 (62.2)	.196	9 (20.0)	36 (80.0)	.002	23 (51.1)	22 (48.9)	.957
Negative	140 (48.1)	151 (51.9)		128 (44.0)	163 (56.0)		150 (51.6)	141 (48.5)	
Drug use stigma									
Other	131 (44.9)	161 (55.1)	.078	113 (38.7)	179 (61.3)	.046	143 (49.0)	149 (51.0)	.017
Strongly agree/agree	26 (59.1)	18 (40.9)		24 (54.6)	20 (45.5)		30 (68.2)	14 (31.8)	
Sleep outside in past 6 months									
Yes	57 (54.3)	48 (45.7)	.061	65 (61.9)	40 (38.1)	.000	54 (51.4)	51 (48.6)	.988
No	100 (43.3)	131 (56.7)		72 (31.2)	159 (68.8)		119 (51.5)	112 (48.5)	
Shelter in past 6 months									
Yes	35 (42.7)	47 (57.3)	.399	44 (53.7)	38 (46.3)	.006	39 (47.6)	43 (52.4)	.413
No	122 (48.0)	132 (52.0)		93 (36.6)	161 (63.4)		134 (52.8)	120 (47.2)	
Frequency of moves in past 6 months									
Zero	79 (46.2)	92 (53.8)	.049	52 (30.4)	119 (69.6)	.000	84 (49.1)	87 (50.9)	.461
One	16 (32.7)	33 (67.4)		17 (34.7)	32 (65.3)		29 (59.2)	20 (40.8)	
Two or more	62 (53.5)	54 (46.6)		68 (58.6)	48 (41.4)		60 (51.7)	56 (48.3)	
Neighborhood disorder									
Not a problem	85 (44.3)	107 (55.7)	.329	43 (22.4)	149 (77.6)	.000	91 (47.4)	101 (52.6)	.072
Somewhat/a big problem	71 (49.7)	72 (50.4)		93 (65.0)	50 (35.0)		82 (57.3)	61 (42.7)	

Table 4 Adjusted prevalence ratios (95% CI) of high source of stress.

	Drug-related financial (<i>n</i> = 336) aPR (95% CI)	Community-level (<i>n</i> = 336) aPR (95% CI)	Drug network (<i>n</i> = 317) aPR (95% CI)
Injected heroin or cocaine in past 6 m	1.34 (1.07–1.67)	–	1.28 (1.04–1.58)
Drug use out of control	1.80 (1.41–2.30)	1.15 (0.91–1.47)	1.37 (1.10–1.70)
Find it difficult to stop using drug(s)	1.55 (1.22–1.97)	1.18 (0.92–1.50)	–
Sex exchange in past 90 days	–	–	1.23 (0.99–1.54)
HIV status	–	0.58 (0.33–1.01)	–
Drug use stigma	–	–	1.32 (1.05–1.65)
Sleep outside in past 6 months	–	1.37 (1.04–1.80)	–
Shelter in past 6 months	–	1.05 (0.82–1.35)	–
Frequency of moves in past 6 months	–	–	–
Zero	–	1.00	–
One	–	1.00 (0.64–1.56)	–
Two or more	–	1.32 (0.98–1.77)	–
Neighborhood disorder	–	2.42 (1.80–3.24)	–

Discussion

Although it is well known that stress is associated with drug use and depression, less is understood about specific sources of stress faced by individuals with this comorbidity. The present study included a population of adults reporting current drug use and probable depressive symptoms, and used exploratory factor analysis to identify distinct sources of stress experienced by this group of adults. We further explored possible correlates associated with high levels of each specific source of stress. We found three distinct sources of stress: drug-related financial, community-level, and drug network. While some correlates of these sources of stress overlapped, others were distinct to the particular source of stress.

Our findings suggest that stress is a complex construct, specifically within a population of individuals who use drugs and report depressive symptoms. We found that three prominent types of sources of stress exist within this population, including financial stress related to obtaining or using drugs, stress due to environmental features, such as problems with family or neighborhood, and stress related to interactions with a person's network. Our results regarding community characteristics as a source of stress are consistent with previous literature exploring environmental stressors and their association with physiological and psychological distress [14], specifically among adults who report

drug use and depressive symptoms [24, 26]. Particular to the financial challenges related to drugs as a source of stress, increased financial vulnerability among this population, as well as increased spending due to problem drug use could provide some rationale [10]. A number of reasons could exist for the identification of drug networks as a source of stress. For example, the influence of social networks on risky drug use behavior [41, 42] or conflict within a social network could also be associated with increase in stress.

Distinct correlates were associated with high levels of three sources of stress. Past 6-month injection drug use, as well as reporting that drug use was out of control and finding it difficult to stop using was associated with high drug-financial as a source of stress. This could relate to specific characteristics of a drug use disorder (e.g., need for larger amounts), as well as general financial instability. These differences also speak of the heterogeneity of drug use (injection and non-injection drug use) present within this population, and suggest that those who inject drugs may be particularly vulnerable to experiencing high levels of drug-related financial stress and stress related to a person's drug network. Sleeping outside in the past 3 months, frequent moves, and the presence of neighborhood disorder were associated with the source of stress related to a person's community. The questions that make up this source of stress specifically ask about the neighborhood a person lives in, as well as current housing situation. Injection drug use, reporting drug use

out of control, and drug use stigma were associated with drug network as a high source of stress. Social network norms related to injection drug use or drug use not specific to injection could impact this stress level [43]. For example, Latkin and colleagues (2003) found norms within a peer network (communication about condom use and using condoms) were associated with reported condom use. Individuals who reported injection drug use were less likely to report condom use within his/her network, and it was proposed that it could have decreased priority in relation to drug use [43]. Therefore, increased stress could be associated with norms promoting risky behaviors. Additionally, a study assessing drug use stigma among adults in Baltimore City found that stigma was associated with increased levels of depression [28]. Further, Link and Phelan [44] explain that stigma associated with drug use may be associated with rejection and discrimination, as well as separation from social groups and loss of status. Two of the three items that make up this source of stress include arguing with drug partners or using drugs with other people, and one question refers to arguing with family about drug use. It is possible that stigma is enhancing problems within different social networks, including family and drug partners.

Limitations

The study utilized a convenience sample of primarily older African American adults in Baltimore City and therefore might not be generalizable to younger populations or individuals in other geographic regions. Additionally, self-report measures were used for all variables (except HIV status), including sources of stress, drug use, and depressive symptoms. Audio computer assisted self-interview was used to minimize bias, but reporting bias could still exist due to the sensitive nature of the questions. Lastly, because of the cross-sectional design, we cannot make any conclusions in regard to causal relationships. Further, because of the interrelationship between stress, drug use and depression, it is plausible that these sources of stress could also predict relevant correlates.

Conclusions

These results emphasize that individuals with co-occurring substance use and depressive symptoms deal with distinct sources of stress related to drug use and financial stability, living environment, as well as

network relationships. This suggests that heterogeneity in the experience of stress might exist, particularly in this population of adults. Future research could benefit by further exploring different sources of stress, as more than what is included in the current study is undeniably plausible. It would also be beneficial to explore sources of stress within other populations with co-occurring depression and drug use, as this sample was primarily Black or African American and 50% reported injection drug use. Future studies could explore other drugs (e.g., those that are not injected, such as marijuana) or other mental health disorders and identify any unique sources of stress. Lastly, understanding influences of related factors on high stress could inform public health interventions among urban adults related to drug use, depression, and stress.

Acknowledgments This work was supported by two National Institutes of Health (NIH) grants [R01DA022961, Latkin PI; T32DA007292, Tormohlen].

Compliance with Ethical Standards The study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Disclaimer The work is solely the responsibility of the authors and does not necessarily reflect the official views of the NIH. The funding source did not play a role in determining study design, data collection, analysis or interpretation, writing the report, or the decision to submit the report for publication.

References

1. Substance Abuse and Mental Health Services Administration. Key substance use and mental health indicators in the United States: results from the 2016 National Survey on Drug Use and Health (HHS Publication No. SMA 17-5044, NSDUH Series H-52). Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration; 2017. <https://www.samhsa.gov/data/>. Accessed 3 Apr 2018.
2. Park-Lee E, Lipari RN, Hedden SL, Kroutil L, Porter JD. Receipt of services for substance use and mental health issues among adults: results from the 2016 National Survey on Drug Use and Health: NSDUH Data Review; 2017. <http://www.samhsa.gov/data/>. Accessed April 3, 2018.
3. Kendler KS, Prescott CA, Myers J, Neale MC. The structure of genetic and environmental risk factors for common psychiatric and substance use disorders in men and women. *Arch Gen Psychiatry*. 2003;60(9):929–37.

4. Conner KR, Pinquart M, Duberstein PR. Meta-analysis of depression and substance use and impairment among intravenous drug users (IDUs). *Addiction*. 2008;103(4):524–34.
5. Khantzian EJ. The self-medication hypothesis of addictive disorders: focus on heroin and cocaine dependence. *Am J Psychiatry*. 1985;142(11):65–74.
6. Brady KT, Sinha R. Co-occurring mental and substance use disorders: the neurobiological effects of chronic stress. *Am J Psychiatr*. 2005;162(8):1483–93.
7. Davis L, Uezato A, Newell JM, Frazier E. Major depression and comorbid substance use disorders. *Curr Opin Psychiatry*. 2008;21(1):14–8.
8. McNiel DE, Binder RL, Robinson JC. Incarceration associated with homelessness, mental disorder, and co-occurring substance abuse. *Psychiatr Serv*. 2005;56(7):840–6.
9. Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Survey. *Arch Gen Psychiatry*. 1994;51(1):8–19.
10. Sinha R. Chronic stress, drug use, and vulnerability to addiction. *Ann N Y Acad Sci*. 2008;1141(1):105–30.
11. Sinha R. How does stress increase risk of drug abuse and relapse? *Psychopharmacology*. 2001;158(4):343–359.
12. Laudet AB, Magura S, Vogel HS, Knight EL. Perceived reasons for substance misuse among persons with a psychiatric disorder. *Am J Orthop*. 2004;74(3):365.
13. Ahern J, Stuber J, Galea S. Stigma, discrimination and the health of illicit drug users. *Drug Alcohol Depend*. 2007;88(2):188–96.
14. Hill TD, Angel RJ. Neighborhood disorder, psychological distress, and heavy drinking. *Soc Sci Med*. 2005;61(5):965–75.
15. Fox HC, Talih M, Malison R, Anderson GM, Kreek MJ, Sinha R. Frequency of recent cocaine and alcohol use affects drug craving and associated responses to stress and drug-related cues. *Psychoneuroendocrinology*. 2005;30(9):880–91.
16. Ouimette PC, Brown PJ, Najavits LM. Course and treatment of patients with both substance use and posttraumatic stress disorders. *Addict Behav*. 1998;23(6):785–95.
17. Hartgers C, Hoek J, Coutinho R, Pligt J. Psychopathology, stress and HIV-risk injecting behaviour among drug users. *Addiction*. 1992;87(6):857–65.
18. Lazarus RS. *Stress and Emotion: A New Synthesis*. New York, NY: Springer Publishing Co; 1999.
19. Cohen S, Kessler RC, Underwood Gordon L. Strategies for measuring stress in studies of psychiatric and physical disorders. In: Cohen S, Kessler RC, Underwood Gordon L, editors. *Measuring Stress: A Guide for Health and Social Scientists*. New York, NY: Oxford University Press, Inc; 1997.
20. Levine S, et al. *Psychoneuroendocrinology*. 2005;30(10): 939–46.
21. Marlatt GA, Donovan DM. *Relapse Prevention: Maintenance Strategies in the Treatment of Addictive Behaviors*. New York, NY: The Guilford Press; 2005.
22. Hammen C. Stress and depression. *Annu Rev Clin Psychol*. 2005;1:293–319.
23. Mazure CM. Life stressors as risk factors in depression. *Clin Psychol Sci Pract*. 1998;5(3):291–313.
24. Latkin C, Curry D. Stressful neighborhoods and depression: a prospective study of the impact of neighborhood disorder. *J Health Soc Behav*. 2003;44(1):34–44.
25. Cohen S, Janicki-Deverts D, Miller GE. Psychological stress and disease. *JAMA*. 2007;298(14):1685–7.
26. Boardman JD, Finch BK, Ellison CG, Williams DR, Jackson JS. Neighborhood disadvantage, stress, and drug use among adults. *J Health Soc Behav*. 2001;42(2):151–65.
27. Young M, Stuber J, Ahern J, Galea S. Interpersonal discrimination and the health of illicit drug users. *Am J Drug Alcohol Abuse*. 2005;31(3):371–91.
28. Latkin C, Davey-Rothwell M, Yang J-Y, Crawford N. The relationship between drug user stigma and depression among inner-city drug users in Baltimore, MD. *J Urban Health*. 2013;90(1):147–56.
29. Tobin K, Davey-Rothwell M, Nonyane B, Knowlton A, Lawrence W, Latkin C. RCT of an integrated CBT-HIV intervention on depressive symptoms and HIV risk. *PLoS One*. 2017;12(12):1–12.
30. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Mes*. 1977;1(3):385–401.
31. Radloff LS, Locke BZ. The community mental health assessment survey and the CES-D scale. In: Weissman MM, Myers JK, Ross CE, editors. *Community Surveys of Psychiatric Disorders*. New Brunswick, NJ: Rutgers University Press; 1986: 177–189.
32. Boyd JH, Weissman MM, Thompson WD, Myers JK. Screening for depression in a community sample: understanding the discrepancies between depression symptom and diagnostic scales. *Arch Gen Psychiatry*. 1982;39(10): 1195–200.
33. Bland JM, Altman DG. Statistics notes: Cronbach's alpha. *BMJ*. 1997;314(7080):572.
34. DeVellis RF. *Scale Development: Theory and Applications*. Thousand Oaks, CA: Sage Publications; 2016.
35. Perkins DD, Meeks JW, Taylor RB. The physical environment of street blocks and resident perceptions of crime and disorder: implications for theory and measurement. *J Environ Psychol*. 1992;12(1):21–34.
36. Kim J-O, Mueller CW. *Factor Analysis: Statistical Methods and Practical Issues*. Uslaner EM, editor. Volume 14. Beverly Hills, CA: Sage Publications; 1978.
37. Kaiser HF. The application of electronic computers to factor analysis. *Educ Psychol Meas*. 1960;20(1):141–51.
38. Holgado-Tello FP, Chacón-Moscoso S, Barbero-García I, Vila-Abad E. Polychoric versus Pearson correlations in exploratory and confirmatory factor analysis of ordinal variables. *Qual Quant*. 2010;44(1):153–66.
39. Costello AB, Osborne JW. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation*. 2005;10(7):1–9.
40. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol*. 2004;159(7): 702–6.
41. Latkin C, Mandell W, Vlahov D, Oziemkowska M, Celentano D. People and places: behavioral settings and personal network characteristics as correlates of needle sharing. *J Acquir Immune Defic Syndr*. 1996;13(3):273–80.

42. Rhodes T, Singer M, Bourgois P, Friedman SR, Strathdee SA. The social structural production of HIV risk among injecting drug users. *Soc Sci Med.* 2005;61(5):1026–44.
43. Latkin CA, Forman V, Knowlton A, Sherman S. Norms, social networks, and HIV-related risk behaviors among urban disadvantaged drug users. *Soc Sci Med.* 2003;56(3):465–76.
44. Link BG, Phelan JC. Conceptualizing stigma. *Ann Rev Sociol.* 2001;27(1):363–85.